



**Office of  
Fissile Materials Disposition**

United States Department of Energy

**Storage and Disposition of  
Weapons-Usable Fissile Materials  
Draft Programmatic Environmental  
Impact Statement**

**Health Risk Data**

**Reading Room Material**

**February 1999**

For Further Information Contact:

U.S. Department of Energy

Office of Fissile Materials Disposition, 1000 Independence Ave., SW, Washington, D.C. 20585

DOE/EIS-0229-D R-026



Office of  
Fissile Materials Disposition

United States Department of Energy

**Storage and Disposition of  
Weapons-Usable Fissile Materials  
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**Reading Room Material**

**Vol 1**

**February 1996**

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# **Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement**

## **Reading Room Materials**

Volumes 1 and 2 contain partial copies of the documents referenced in the *Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement* (PEIS), DOE/EIS-0229-D. References are provided in alphabetical order by citation. Each reference consists of the following information from the document:

- the cover page and page(s) referenced are included for documents cited as a source in the text
- the cover page alone is included for documents cited as a source in tables and figures

A complete list of all documents cited is included in Chapter 5 of the PEIS. Documents that are readily available to the public through university and public libraries are not included in this set of reference documents. This type of document includes the following:

- Regulations (for example, *Code of Federal Regulations* or State regulations)
- Orders (for example, Department of Energy Orders)
- Census and other data from the Department of Commerce Bureau of the Census
- Computer software (for example, RADTRAN)
- Databases (for example, waste and socioeconomic data)
- Copyrighted materials
- Annual site environmental reports
- Maps (for example, geologic surveys)
- Aerial photographs
- Textbooks and other reference books (for example, *CRC Handbook of Chemistry and Physics*)

In addition to this two-volume set of references, several other documents are provided in their entirety, including storage and disposition alternative data reports. These documents are included because they are used extensively in the PEIS. A complete list of these documents is attached.

If there are questions about this material, please contact Mr. G. Bert Stevenson, Office of NEPA Compliance and Outreach, Office of Fissile Material Disposition, U.S. Department of Energy, 1000 Independence Avenue, SW, Washington, D.C., 20585. Mr. Stevenson can be reached by phone at (202) 586-5368.

Separate from this volume, the following documents are provided in their entirety:

- DOE 1995c      *Data Report to Support the Programmatic Environmental Impact Statement for the Consolidated Special Nuclear Material Storage Plant, Review and Comment, U.S. Department of Energy, Office of Fissile Materials Disposition, Revision B, June 1995.*
- DOE 1995k      *Data Report to Support the Programmatic Environmental Impact Statement for the Collocated Highly Enriched Uranium/Special Nuclear Material Storage Plant, Review and Comment, U.S. Department of Energy, Office of Fissile Materials Disposition, Revision B, July 1995.*
- HF DOE 1996a      Sandberg, D.E., J.A. Teal, R.C. Hoyt, RE. Barker, T.J. Ventz, T.L. Waldo, *Hanford Site Data for the Weapons Complex Reconfiguration Programmatic Environmental Impact Statement, DOE/RL-93-0100, U.S. Department of Energy, Richland, WA, Revision 0, February 1996.*
- HNUS 1996a      Halliburton NUS Corporation, *Health Risk Data for Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement*, prepared for the U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, February 1996.
- IN FDI 1996a      Fluor Daniel, Inc., *Data Report to Support the Programmatic Environmental Impact Statement for the Argonne National Laboratory-West Plutonium Storage Upgrade Plant, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, Revision A1, January 1996.*
- LANL 1996b      *New Mixed Oxide Fuel Fabrication Facility Data Report for the Fissile Material Disposition Program Programmatic Environmental Impact Statement, LA-UR-95-4442, Los Alamos National Laboratory, Los Alamos, NM, 1996.*
- LANL 1996c      Smith, W.B., D.D. Wilkey, and D. Siebe, *Data Report for Plutonium Conversion Facility, LA-UR-95-1721, Los Alamos National Laboratory, Los Alamos, NM, February 1996.*
- LANL 1996d      Cremers, T.L., M.C. Bronson, and D.C. Riley, *Fissile Material Disposition Program: Pit Disassembly and Conversion Facility Data Call Input, LA-UR-96-474, Los Alamos National Laboratory, Los Alamos, NM, February 1996.*
- LLNL 1996a      *Fissile Material Disposition Program Deep Borehole Disposal Facility PEIS Data Input Report for Direct Disposal—Direct Disposal of Plutonium/Plutonium Dioxide in Compound Canisters, UCRL-ID-119481, Lawrence Livermore National Laboratory, University of California, Livermore, CA, Version 3.0, January 15, 1996.*

- LLNL 1996b *Fissile Material Disposition Program PEIS Data Call Input Report: Immobilization of Surplus Fissile Material with Electrometallurgical Treatment of Spent Fuels*, UCRL-ID-122667, L-20768-1, Lawrence Livermore National Laboratory, University of California, Livermore, CA, Version 3.0, February 9, 1996.
- LLNL 1996c *Fissile Material Disposition Program PEIS Data Call Input Report: New Glass Vitrification Facility*, UCRL-ID-122658, L-18833-1, Lawrence Livermore National Laboratory, University of California, Livermore, CA, February 9, 1996.
- LLNL 1996d *Fissile Material Disposition Program PEIS Data Call Input Report: Ceramic Immobilization Facility with Radionuclides*, UCRL-ID-122665, L-20590-1, Lawrence Livermore National Laboratory, University of California, Livermore, CA, February 9, 1996.
- LLNL 1996e *Fissile Material Disposition Program PEIS Data Call Input Report: Ceramic Immobilization Facility Using Coated Pellets Without Radionuclides*, UCRL-ID-122666, L-20588-1, Lawrence Livermore National Laboratory, University of California, Livermore, CA, February 9, 1996.
- LLNL 1996g *Evolutionary/Advanced Light Water Reactor Data Report*, UCRL-ID-123411, prepared by Lawrence Livermore National Laboratory, University of California, Livermore, CA, and Oak Ridge National Laboratory, Oak Ridge, TN, for the U.S. Department of Energy, Fissile Materials Control and Disposition Program, Washington, DC, February 9, 1996.
- LLNL 1996h *Fissile Material Disposition Program: Deep Borehole Disposal Facility PEIS Data Input Report for Immobilized Disposal—Immobilized Disposal of Plutonium in Coated Ceramic Pellets in Grout Without Canisters*, UCRL-LR-119735, prepared by Lawrence Livermore National Laboratory, University of California, Livermore, CA, January 15, 1996.
- NT DOE 1996a Fluor Daniel, Inc., *Draft Data Report to Support the Programmatic Environmental Impact Statement for the Nevada Test Site Storage Plant*, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, Revision A1, January 1996.
- OR MMES 1996a Everitt, D.A., J.P. Johnson, J.K. Phillips, and J.D. Snider, *PEIS Data Report: Upgrading the Y-12 Plant for Long-Term HEU Storage*, Martin Marietta Energy Systems, Inc., Y/ES-043/R2, Oak Ridge Y-12 Plant, Oak Ridge, TN for the U.S. Department of Energy, Washington, DC, February 1996.
- ORNL 1995b *Letter Report FMDP LWR PEIS Data Report*, ORNL/MD/LTR-42, Oak Ridge National Laboratory, Fissile Materials Disposition Program, Reactor-Based Technologies, Facility Project, Oak Ridge, TN, Revision 3, December 21, 1995.

- PX DOE 1996a      Fluor Daniel, Inc., *Draft Data Report to Support the Programmatic Environmental Impact Statement for the Consolidated Special Nuclear Material Storage Upgrade at the Pantex Plant*, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, Revision A1, January 1996.
- PX MH 1995f      Mason & Hanger-Silas Mason Co., Inc., *Data Report on Upgrade Alternative for the Pantex Plant Pu Storage Operations*, RPT10 Revision, Pantex Plant, Amarillo, TX, December 1995.
- Socio 1996a      *Supplemental Socioeconomic Data Report Storage and Disposition of Weapons-Usable Fissile Materials PEIS*, February 1996.
- SR DOE 1994e      *PEIS Upgrade Data Report on Plutonium Storage at the Savannah River Site*, NMP-PLS-940288, Volume I, Revision 3, August 1, 1994.
- TRW 1996a      *Interim Report on Evaluation of Plutonium Waste Forms for Repository Disposal*, prepared by TRW Environmental Safety Systems Inc., Vienna, VA, for the U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Washington, DC, Revision 0d, February 9, 1996.
- TTI 1996c      Tan, Z.R. and H.M. Blauer, *Calculation of Avoided Human Health Impacts from the Uranium Fuel Cycle by Blending Weapons-Usable Fissile Materials (Plutonium and Highly Enriched Uranium) for Use as Replacement Reactor Fuel*, prepared by Tetra Tech, Inc., Falls Church, VA, for the U.S. Department of Energy, Office of Fissile Materials Disposition (MD-4), Washington, DC, February 1996.
- TVA 1995b      *Partially Completed Reactors (Construction Phase Only) Data Call Package*, Tennessee Valley Authority, Hollywood, AL, July 13, 1995.

### Supplemental Documents

*Fissile Material Disposition Program: Screening of Alternate Immobilization Candidates for Disposition of Surplus Fissile Materials*, UCRL-ID-118819, L-20790-1, Lawrence Livermore National Laboratory, University of California, Livermore, CA, February 9, 1996.

*Letter Report FMDP CANDU PEIS Data Report*, Oak Ridge National Laboratory, Fissile Materials Disposition Program, Reactor-Based Technologies, Facility Project, June 5, 1995.

National Academy of Sciences, *Management and Disposition of Excess Weapons Plutonium*, National Academy Press, Washington, DC, 1994.

National Academy of Sciences, *Management and Disposition of Excess Weapons Plutonium Reactor-Related Options*, National Academy Press, Washington, DC, 1995.

*AECL 1994a*

**Plutonium Consumption Program  
CANDU Reactor Project**

**Final Report  
July 31, 1994**

**Work performed for the U.S. Department of Energy**

**Contract DE-AC03-94SF20218**

**by**

**AECL Technologies Inc.  
9210 Corporate Boulevard  
Suite 410  
Rockville, Maryland 20850**

AECL 1994a

This document was replaced by *Letter Report FMDP CANDU PEIS Data Report*, Oak Ridge National Laboratory, Fissile Materials Disposition Program, Reactor-Based Technologies, Facility Project, June 5, 1995, which has been included in its entirety as a supplemental document.

BW NEG 1985b  
NUREG-0987

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**Environmental Impact Appraisal**  
for renewal of  
Special Nuclear Material  
License No. SNM-1168

5/31/83

Docket No. 70-1201

Babcock & Wilcox Company  
Commercial Nuclear Fuel Plant

**U.S. Nuclear Regulatory  
Commission**

Office of Nuclear Material Safety and Safeguards

May 1983



CO DPHE 1994a

**Ambient Air Standards  
For the state of Colorado**

**COLORADO AIR QUALITY CONTROL COMMISSION**

DHHS, 1992a

**DHHS 1992a**

## **Sixth Annual Report on**

# **Carcinogens**

## **Summary 1991**

**U.S. DEPARTMENT OF  
HEALTH AND HUMAN SERVICES  
Public Health Service**

Prepared for the  
**NATIONAL INSTITUTE OF  
ENVIRONMENTAL HEALTH SCIENCES**  
Research Triangle Park, NC 27709

By  
Technical Resources, Inc.  
Rockville, MD 20852  
Under Contract Number  
N01 ES 3 5025

DOE 1985a

ARGONNE NATIONAL LABORATORY

APR 1 1990

ELISABETH ANN STULL  
Environmental Assessment and  
Information Sciences Division

**DEPARTMENT OF ENERGY  
NATIONAL ENVIRONMENTAL  
RESEARCH PARKS**

**AUGUST 1985**

**FILE COPY**



**U.S. Department of Energy**

**Office of Energy Research  
Office of Health & Environmental Research  
Ecological Research Division**

## NATIONAL ENVIRONMENTAL RESEARCH PARKS

### Introduction

The National Environmental Research Parks (NERPS) are outdoor laboratories set aside for ecological research to study the environmental impacts of energy developments, and for informing the public of the environmental and land-use options open to them. The Parks were established under the Department of Energy (DOE) to provide protected land areas for research and education in the environmental sciences, and to demonstrate the environmental compatibility of energy technology development and use.

The concept of the Environmental Research Park is an outgrowth of the National Environmental Policy Act of 1969 and the demonstrated public desire for a quality environment. It is also consistent with the policy statement of the Federal Council for Science and Technology: "Unique, unusual and expensive-to-duplicate facilities at Federal laboratories and federally-supported research centers should be made available to the national scientific community to the maximum extent practical without serious detriment to laboratory missions. Criteria for such use should be the scientific merit of the proposed experiment, its relation to the agency research mission, and its contribution to national research and research training." (1969).

A wide range of research and demonstration programs are necessary to address systematically the environmental aspects of human activities. Environmental research parks not only provide sites on which to conduct general research but also are used for specific environmental research programs. Objectives are: (1) to develop methods for assessing and monitoring, both quantitatively and continuously, the environmental impacts of human activities; (2) to develop methods for predicting the environmental impacts of proposed and ongoing energy-development; (3) to demonstrate impacts of various energy activities on the environment; and (4) explore methods for minimizing adverse effects.

Five DOE sites have been designated as Environmental Research Parks. (Figure 1). These sites have been especially valuable for research concerning plant succession, biomass production, radionuclide cycling, demonstration of costs and effectiveness of recolonization of disturbed lands, thermal effects in freshwater ecosystems, and for research training of students.

The first Park designated was at the Savannah River Plant in South Carolina in 1972. This site provides areas of cypress swamp, southeastern pine, and hardwood forests for research. It is representative of the Southeastern Coastal Plain region.

The Idaho National Engineering Laboratory, in southeastern Idaho was designated as a Park in January 1975. The site offers expanses of the very large (eastern Washington to Wyoming) arid sagebrush steppe ecosystem at elevations up to 1445 m (4769 ft.).

The Park at Hanford, Washington (designated in 1975), offers a wide range of arid land ecosystems at elevations between 130 and 1160 m. Several watersheds offer a unique opportunity to examine linkages between terrestrial, subsurface and aquatic environments on a systems basis. Although Idaho and Hanford represent widely separated sites within the same biome, each site offers excellent opportunity for cross checking and validation of environmental data transfer techniques.

The Los Alamos, New Mexico NERP (established in 1977), allows energy-environmental studies in Pinyon-Juniper woodland ecosystems. Studies at Los Alamos National Laboratory have also been carried out on several archaeological sites located in the Park.

The Park on the Oak Ridge Reservation in Tennessee was designated on June 5, 1980. The site is representative of a large segment of the ridge and valley physiographic province and the important energy-impacted eastern deciduous forest biome.

The Fermi National Laboratory is presently applying for NERP status.

Descriptions of each environmental research park follow in alphabetical order.

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**DOE 19866**

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**Nuclear Waste Policy Act**  
(Section 112)

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# Environmental Assessment

*Yucca Mountain Site, Nevada Research  
and Development Area, Nevada*

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**Volume I**

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**May 1986**

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**U.S. Department of Energy**  
Office of Civilian Radioactive Waste Management  
Washington, DC 20585

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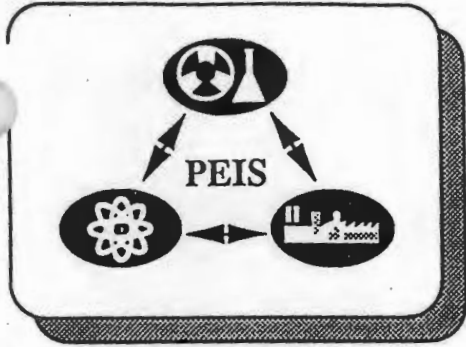
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# **U.S. DOE Nuclear Weapons Complex Modernization Report**

**Report to the Congress  
by the  
President**

**December 1988**

DOE 1991h

DOE/RW-0006, Rev. 7

# **Integrated Data Base for 1991: U.S. Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics**

October 1991



Prepared by:

**Oak Ridge National Laboratory**  
Managed by Martin Marietta Energy Systems, Inc., for the  
U.S. Department of Energy under contract DE-AC05-84OR21400

Prepared for:

**U.S. Department of Energy**  
Office of Civilian Radioactive Waste Management  
Office of Environmental Restoration and Waste Management  
Washington, D.C. 20585

## PREFACE

The information in this report summarizes the U.S. Department of Energy (DOE) data base for inventories, projections, and characteristics of domestic spent nuclear fuel and radioactive waste. This report is updated annually to keep abreast of continual waste inventory and projection changes in both government and commercial sectors. Baseline information is provided for planning purposes and to support program decisions. Although the primary purpose of this document is to provide background information for program planning within the DOE community, it has also been found useful by state and local governments, the academic community, and a number of private citizens. To sustain the objectives of this program in providing accurate and complete data in this field of operation, comments and suggestions to improve the quality and coverage are encouraged. Such comments and any general inquiries should be directed to:

U.S. Department of Energy  
Office of Civilian Radioactive Waste Management  
Route Symbol RW-432  
Washington, DC 20585

This report was prepared by the Integrated Data Base Program, which is jointly sponsored by the Office of Civilian Radioactive Waste Management and the Office of Environmental Restoration and Waste Management. Suggestions, questions, and requests for information may be directed to any of the following:

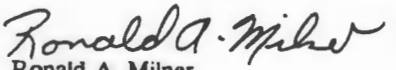
M. L. Payton, DOE/RW-432, Washington, DC 20585  
Telephone: (202) 586-9867

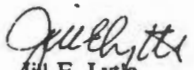
J. S. Kang, DOE/EM-35, Washington, DC 20545  
Telephone: (301) 353-7178


J. W. Gatrell, DOE/EM-451, Washington, DC 20545  
Telephone: (301) 353-7221

J. A. Klein, ORNL, P.O. Box 2008, Oak Ridge, TN 37831-6495  
Telephone: (615) 574-6823

An important part of the Integrated Data Base Program is the Steering Committee, whose members provide both generic guidance and technical input. The membership of this Committee, shown on the following page, represents all of the major DOE sites and programs for spent fuel and radioactive waste management. Each support committee member is assisted by a technical liaison as needed and by a DOE liaison as appropriate. The participation and assistance of these individuals are acknowledged with appreciation.

  
Ronald A. Milner  
Associate Director  
Office of Storage and Transportation  
Office of Civilian Radioactive  
Waste Management

  
J. E. Lytle  
Associate Director  
Office of Waste Operations  
Office of Environmental Restoration  
and Waste Management

  
Roger P. Whitfield  
Associate Director  
Office of Environmental Restoration  
Office of Environmental Restoration  
and Waste Management

DOE 1991j  
DOE 1991j

**NUCLEAR WEAPONS COMPLEX RECONFIGURATION-  
SITE EVALUATIONS**

**A  
REPORT  
BY THE NWCR  
SITE EVALUATION PANEL**

**TRITIUM SUPPLY AND RECYCLING  
PROGRAMMATIC ENVIRONMENTAL IMPACT  
STATEMENT**

This document has been released to the public and should be available at this Reading Room. If unable to locate, Reading Room staff can request a copy be made for delivery to this room within 2 working days

*(PREDECISIONAL)*

**OCTOBER 1991**

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## METHODOLOGY AND EVALUATION PROCEDURES

The procedures employed in the evaluation of proposals/information packages were specified in the approved Proposal Evaluation Methodology for the Panel. The evaluation process consisted of the following primary steps:

1. Qualification Screening of all Proposals/Information Packages Received; and
2. Comprehensive Technical Evaluation of all Proposals/Information Packages Passing Qualification Review.

The qualification criteria and technical evaluation criteria utilized in the above steps were specified in the Invitation, and are reproduced in Appendix C of this report. To facilitate the evaluation process, the Panel Chairman assigned lead responsibility for each of the technical evaluation criteria to a sub-panel. Each sub-panel was chaired by a voting member of the Panel.

### Qualification Screening

The Panel's assessment of proposals/information packages began in June 1991 with a review to determine which proposals/information packages met the qualification criteria. Appropriate sub-panels were assigned responsibility for initial evaluations of each proposal/information package against the qualification criterion. In consultation with sub-panel members and advisors, each sub-panel chairman assessed each proposal/information package in his respective area of responsibility and reported the observations to the entire Panel. The Panel compared each proposal against each qualification criterion until a consensus was reached. The Panel determined that all five proposals/information packages met the qualification criteria and contained sufficient information to permit a comprehensive evaluation. These proposers received individual written notification and a public announcement was made which identified all qualified proposals/information packages.

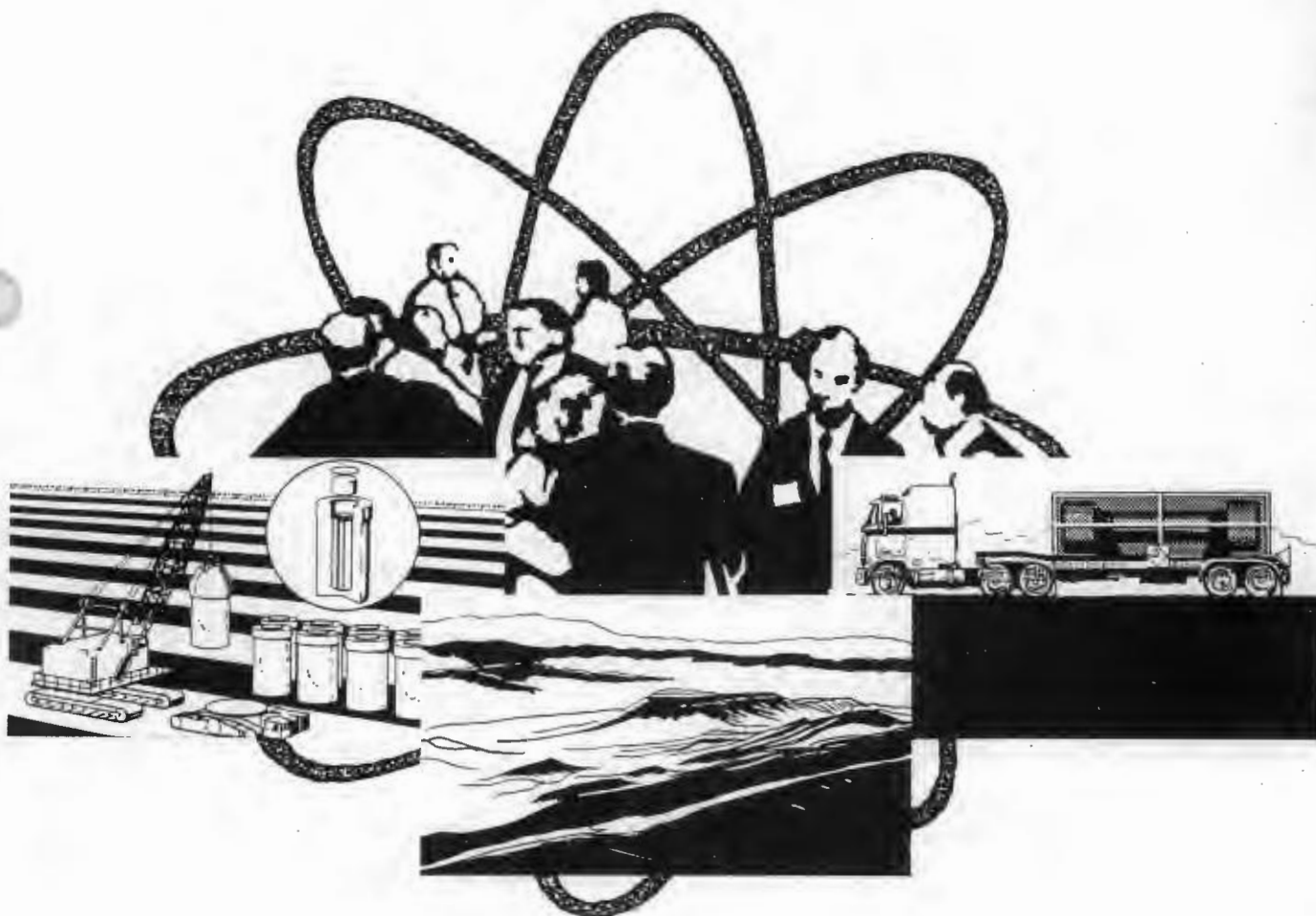
### Comprehensive Technical Evaluations

Following the initial qualification process, the Panel conducted a comprehensive technical evaluation of the proposals/information packages consistent with the technical evaluation criteria specified in the Invitation. Unless there was evidence to the contrary, the Panel considered, for evaluation purposes, the data in the proposals/information packages as factual. If any of the proposal data appeared questionable, lacked clarity and/or completeness, the Panel requested and obtained clarifications to the specific concerns. All interactions between the Panel and proposers were documented. Proposers were not permitted to revise their proposals/information packages as a result of any clarifications. In addition to evaluating the information contained in each proposal, the Panel also conducted a site visit to each proposed location, and included the information gained during these site visits in the evaluation process.

The comprehensive technical evaluation process consisted of two parts: individual evaluation of each proposal by each voting member of the Panel; and in depth evaluation of each proposal by each of the technical sub-panels. Each sub-panel provided a report on each site to the Panel at the conclusion of its evaluation. When all the site visits were completed, the voting members of the Panel met and discussed in detail the individual strengths and weaknesses documented by each voting member, and as reported to the Panel by each sub-panel. Discussions continued until a consensus was reached on a common understanding of the major strengths and weaknesses of each proposal, and the potential mitigation of any weaknesses. Based upon this consensus, an adjectival rating was developed for each criterion (and subcriterion as appropriate) for each proposal. Potential ratings were "outstanding," "good," "satisfactory," "poor," or "unsatisfactory." The Panel evaluated the proposals/information packages and made site visits to determine those best qualified to receive the nuclear weapons complex functions now located at either (1) Rocky Flats alone, (Option 1); or (2) collocation of Rocky Flats and Y-12 or Pantex, or all three (Option 2). The list of best qualified sites is contained in Chapter Four. At no point during the evaluation process, were proposals/information packages compared against each other. Rather, each proposal was individually evaluated against the criteria specified in the Invitation.

DOE 1991n

# *Draft Mission Plan Amendment*



U.S. Department of Energy  
Office of Civilian Radioactive Waste Management

September 1991

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Available from:

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Oak Ridge, TN 37831

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# Environmental and Other Evaluations of Alternatives for Siting, Constructing, and Operating New Production Reactor Capacity

Volume 1: Sections 1-10

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U.S. Department of Energy  
Office of New Production Reactors



September 1992

TABLE 4.1.5-1 Threatened and Endangered Species that Could Be Found in the Vicinity of NPR Facilities on the Hanford Site

Species	Status <sup>a</sup>		Known or Potential Location on NPR Site or Affected Areas
	Federal	State	
Plants			
Columbia yellow cress	C2	E	Riparian areas along Columbia River <sup>b</sup>
Mollusks			
Giant Columbia River limpet	C2	NL	Hanford Reach of Columbia River <sup>c</sup>
Giant Columbia River spire snail	C2	NL	Hanford Reach of Columbia River <sup>c</sup>
Birds			
Bald eagle	T	T	Hanford Townsite <sup>c</sup>
Peregrine falcon	E	E	NPR site, <sup>b</sup> Hanford Reach of Columbia River <sup>b</sup>
Swainson's hawk	C2	NL	NPR site, <sup>c</sup> Hanford Townsite <sup>c</sup>
Ferruginous hawk	C2	T	NPR site <sup>c</sup>
Long-billed curlew	C2	NL	NPR site <sup>c</sup>
White pelican	NL	E	Hanford Reach of Columbia River <sup>c</sup>
Sandhill crane	NL	E	NPR site, <sup>b</sup> Hanford Reach of the Columbia River <sup>c</sup>
Common loon	NL	C	Hanford Reach of Columbia River <sup>c</sup>

<sup>a</sup>Status: C = state candidate species; C2 = Category 2 species; E = endangered species; NL = not listed; and T = threatened species.

<sup>b</sup>Potentially on NPR site or affected area.

<sup>c</sup>Known to occur on NPR site or affected area.

Source: Modified from Cushing 1989.

Several species that are candidates for listing by the Federal government (Category 2 species) are found in areas where construction activities would occur (Cushing 1990). These species include the long-billed curlew (nests throughout the NPR site), the ferruginous hawk (nests on the 230- and 500-kV transmission towers approximately 1 km from the NPR site and forages over the NPR site), and the Swainson's hawk (forages over the NPR site and nests at the Hanford Townsite). Habitats similar to those used by these species for foraging are relatively common on Hanford; nesting sites, however, are more limited. Two other Category 2 species -- the giant Columbia River limpet and the giant Columbia River spire snail -- are found in the Hanford Reach of the Columbia River. Although Category 2 species do not receive legal protection under the Endangered Species Act, the U.S. Fish and Wildlife Service (FWS) recommends that impacts to these species be considered in project planning.

Three salmon stocks have recently been proposed for listing by the National Marine Fisheries Service (NMFS) as threatened or endangered. These stocks include the Snake River sockeye salmon (proposed endangered), the spring/summer Snake River chinook salmon, and the fall Snake River chinook salmon. These stocks occur within the Columbia River below the

confluence with the Snake River. The confluence of these two rivers is approximately 40 km downstream of the Hanford NPR site and is considered outside of the affected environment of an NPR.

Columbia yellow cress, a Federal Category 2 and state-endangered plant species, occurs in riparian areas along the Columbia River (Cushing 1989) and could be present in areas disturbed during construction of the pump house and cooling water intake and discharge lines for an HWR or MHTGR. Several other state-listed species occur in areas that would be affected by an NPR. These include the white pelican and sandhill crane (both endangered) and the common loon (a candidate for listing) (Cushing 1989). All three of these species use the Hanford Reach of the Columbia River, and the sandhill crane could also be found on the NPR site. State laws do not provide legal protection for state-listed species on Federally owned land, but these species are considered here because of their regional importance.

#### 4.1.6 Cultural Resources

Fifteen surveys have been conducted in areas that would be affected by the construction of an NPR at the Hanford Site. These surveys, combined with other data, indicate that the affected areas contain two isolated artifacts (NPR site), one prehistoric site and the historic Hanford Townsite (water intake and discharge corridor for the NPR site), two historic archaeological sites (near the NPR site), and five historic structures (200-East Area). Determinations of eligibility for the National Register of Historic Places (NRHP) will be made by the Washington State Historic Preservation Officer (SHPO). Consultations with potentially affected Native American groups, some of whom consider the area a homeland, have been initiated by DOE.

##### 4.1.6.1 Regional Prehistory, History, and Ethnography

The archaeological record of the mid-Columbia region begins more than 11,000 years ago with Clovis hunters, whose distinctive spear points have been found scattered throughout the Northwest. Subsequently (10,700-3,500 years before present [B.P.]), people lived as nomadic foragers in the more arid central portions of the region, which includes the current Hanford Site. By 3,500-3,000 B.P., people had adopted a collector strategy (subsistence based on food harvesting and storage). During productive seasons, these people focused on harvesting and preserving provisions, which they later consumed while spending the winters in large pithouses. By 2,000 B.P., pithouses had become aggregated into villages in a pattern that continued into the period of Euro-American contact. Introduction of the horse in the mid-18th century transformed settlement and subsistence patterns among many peoples in the region (Chatters 1989; Daugherty 1962; Leonhardy and Rice 1970).

In late prehistoric and early historic times, Wanapums lived along the west bank of the Columbia River from south of the Richland area upstream to the Vantage area (Relander 1956; Spier 1936). Some of their descendants still live nearby, and others have been incorporated into the Yakima and Umatilla reservations. Palus people, whose descendants now live on the Nez Perce, Yakima, Umatilla, and Colville reservations, inhabited parts of the east bank of the Columbia River (Relander 1956; Trafzer and Scheuerman 1986).

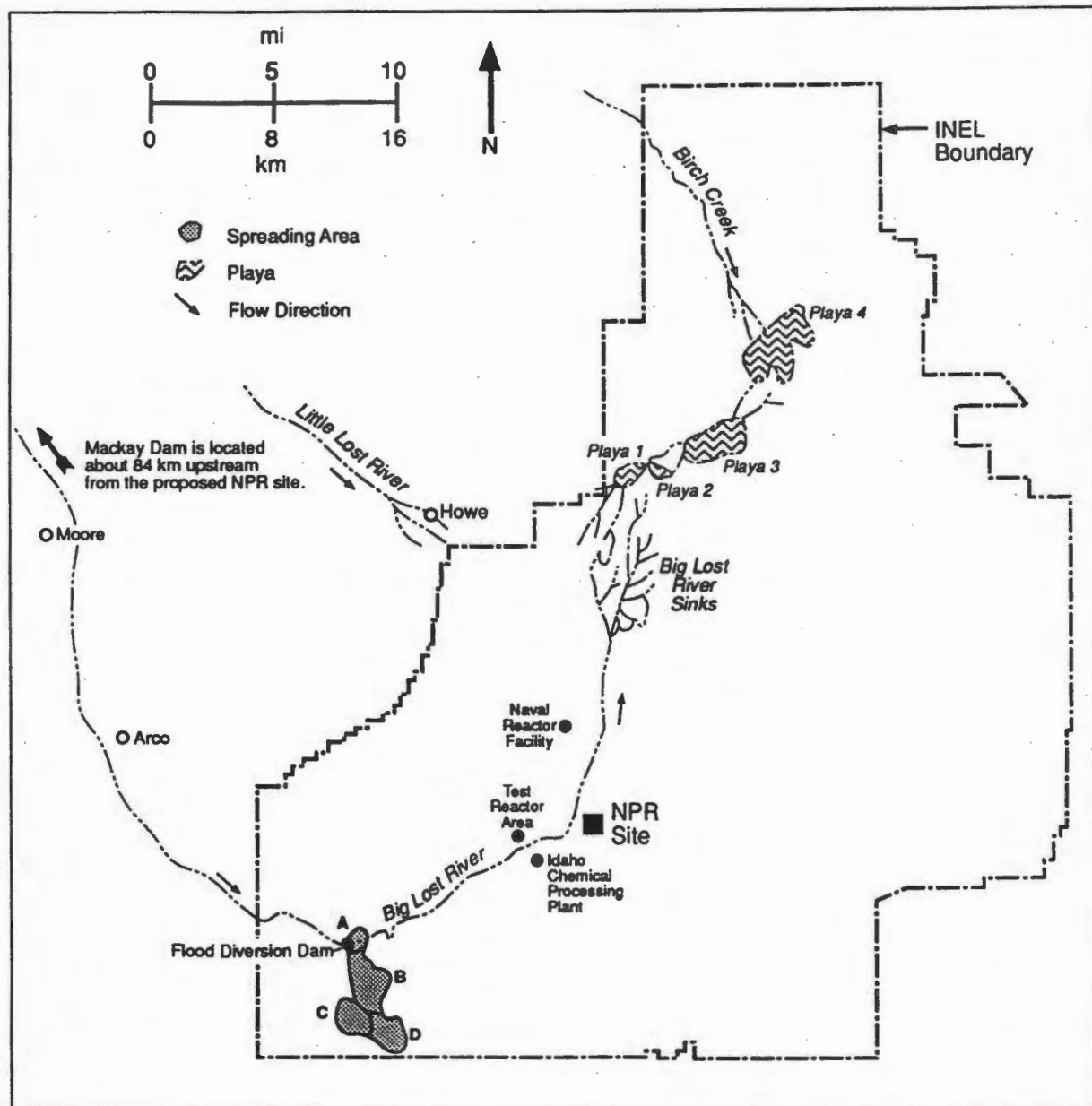


FIGURE 4.2.3-1 Surface Water Features in the Vicinity of INEL (Source: Modified from EG&G-1)

### Groundwater Quality

Two groundwater monitoring networks are operated at INEL: one by the U.S. Geological Survey and the other by the Radiological and Environmental Sciences Laboratory.

The USGS network is composed of more than 200 wells on and near INEL. Of these, 120 wells are used to sample groundwater in the Snake River Plain aquifer, and 100 are used to sample groundwater in the perched zones (DOE-27). Wells are sampled for both water level and chemical constituents. The wells sampled by the Radiological and Environmental Sciences Laboratory include INEL water supply wells, wells that monitor the migration of constituents from INEL facilities, and off-site water supply wells. These wells are sampled for chemical and radiological constituents.

Analyses of groundwater in the Snake River Group basalt performed by the U.S. Geological Survey (Yee and Souza 1987) indicate that the maximum concentrations of inorganic constituents and coliform bacteria in the Snake River Plain aquifer in the vicinity of INEL exceed drinking water standards, where promulgated. At the NPR site, water samples from the NPR test well have been analyzed for more than 50 chemical parameters (tritium, organic compounds, and heavy metals) since 1986 (based on data retrieved from the U.S. Geological Survey quality of water database). All analytical results show low values often at or near the detection limits.

Radioactive and chemical wastes discharged since 1952 to unlined ponds and deep wells at INEL have affected water quality in localized areas in the perched groundwater zones and in the Snake River Plain aquifer. As a result of effluent disposal into unlined ponds, tritium (a mobile radionuclide) has been detected in the perched zone in the Test Reactor Area (Figure 4.2.3-3) in concentrations above the State of Idaho drinking water standard (20,000 pCi/L) (Pittman, Jensen, and Fischer 1988). Localized plumes of groundwater containing low levels of radionuclides and chemical constituents also occur in the Snake River Plain aquifer from injection of wastes into the ground (Pittman, Jensen, and Fischer 1988; Lewis and Jensen 1984; Robertson 1977). Low-level radioactive and chemical wastes from the Idaho Chemical Processing Plant were discharged directly into the ground through a 180-m-deep well from 1953 until February 1984. Since 1984, wastes from the plant have been disposed of in unlined ponds, although the disposal well was available for use in emergency situations from 1984 to 1986 (Pittman, Jensen, and Fischer 1988).

Plumes of contaminated groundwater containing radioactive waste products (e.g., tritium, strontium-90, iodine-129, cesium-137, and plutonium-238) have migrated downgradient (south) from the Idaho Chemical Processing Plant and the Test Reactor Area (Figure 4.2.3-4). The maximum concentration of tritium detected in wells at INEL in 1987 in the Snake River Plain aquifer was 80,600 pCi/L (Knobel and Mann 1988). Tritium, being the most mobile of these radionuclides, has migrated the farthest, followed by iodine and strontium. Cesium and plutonium have migrated less than 0.8 km. Most other radionuclides are either sorbed on the materials surrounding the disposal areas, decay to low levels before entering the aquifer, or are not discharged in sufficient quantities to be detected in the aquifer. In recent years, the tritium plume near the southern boundary of INEL has receded because of radioactive decay (Pittman, Jensen, and Fischer 1988).

#### 4.2.5.1 Terrestrial Resources

Most land within the boundaries of INEL is relatively undisturbed and provides important habitat for species native to the region. Several nuclear production facilities are located on the site, and 60% of the site is grazed by sheep and cattle (McBride et al. 1978). The INEL is within a cool desert ecosystem characterized by shrub-steppe communities. The flora (Table G.3) is typical of the Columbia Plateau province (Atwood 1970). Sagebrush communities occupy the greater part of INEL, but communities dominated by juniper, crested wheatgrass, and Indian ricegrass are also present (Figure 4.2.5-1) (McBride et al. 1978).

The INEL supports numerous animal species, including 1 amphibian, 9 reptile, 184 bird, and 37 mammal species (Table G.3). Common animal species on INEL include the short-horned lizard, gopher snake, horned lark, sage sparrow, Townsend's ground squirrel, and black-tailed jackrabbit. The INEL supports several species of game animals, but DOE allows hunting on the site only near the northern boundary. Important game animals present include several waterfowl species, sage grouse, pronghorn, elk, and mule deer. About 30% of Idaho's total pronghorn population winters on INEL. The INEL is also an important nesting and wintering area for hawks and owls. The juniper communities on the site provide important nesting habitat for these species (Craig 1979).

A preliminary vegetation survey of the NPR site at INEL was conducted in 1990 (Anderson, Glennon, and Houser 1990). The entire site is underlain by basalt lava flows of varying ages, and the dominant vegetation in areas where soils are shallow (over 90% of the site) is big sagebrush (Anderson, Glennon, and Houser 1990). Perennial grasses dominate low-lying depressions where deep, fine soils have accumulated. Common plant species on the NPR site include big sagebrush, rabbitbrush, cheatgrass, bottlebrush squirreltail, thickspike wheatgrass, Indian ricegrass, and needle-and-thread grass. Several isolated stands of juniper also are present on the site. On the whole, the vegetation and habitats on the NPR site appear typical of those developed on lava flows over much of the central portion of INEL (Anderson, Glennon, and Houser 1990).

Although surveys have not been conducted to determine the relative abundance of animal species on the NPR site, the animal habitat present there appears typical of other areas of INEL (Anderson, Glennon, and Houser 1990). Elk use areas in the vicinity of the NPR site during the fall, winter, and spring, but pronghorn use of the NPR site is low relative to other areas of INEL. Sage grouse are known to use the NPR site, but not for breeding purposes. The isolated juniper stands located in the southeastern and northeastern portions of the site provide potential nesting habitat for hawks and owls.

Some NPR support facilities would be developed on the Idaho Chemical Processing Plant site. This area is surrounded by a fence, supports ongoing industrial activities associated with INEL operations, and contains little undisturbed habitat.

#### 4.2.5.2 Wetlands

Although most of INEL is desert, more than 800 ha of wetlands exist during periods of high flow in the Big Lost River (Staley 1989), which enters the southwestern corner of INEL and flows north (Figure 4.2.5-1). The Big Lost River spreading areas and Big Lost River sinks are

major wetlands on INEL and are located, respectively, about 16 km southwest and 20 km north of the NPR site. These areas provide habitat for migratory waterfowl, shorebirds, and other wildlife species during wet years, but they have not held water since 1986. No wetlands are located on the NPR site.

Riparian wetland vegetation (primarily cottonwoods and willows) along the Big Lost River and along Birch Creek (which enters the northern part of INEL and flows south into the sink area) provides nesting habitat for hawks, owls, and numerous songbirds. The riparian vegetation along the Big Lost River, however, currently is in poor condition because irrigation withdrawals and recent drought have caused flows to be intermittent.

#### 4.2.5.3 Aquatic Resources

The Big Lost River flows intermittently across about 50 km of INEL, from southwest to north, before it terminates in the Big Lost River sinks (Figure 4.2.5-1). Drought and upstream diversions have resulted in no spring or summer flows onto INEL since 1986. However, when water is flowing, six species of fish have been observed in the Big Lost River (Table G.3). No aquatic habitat occurs on the NPR site, and the site is about 2.5 km southeast of the Big Lost River.

#### 4.2.5.4 Threatened and Endangered Species

Seventeen Federally and state-listed threatened and endangered species have been identified on and in the vicinity of INEL (Appendix G, Table G.4). Five of these species occur on or in the vicinity of sites designated for NPR facilities (Table 4.2.5-1). These species are discussed in greater detail in Appendix G (Section G.2). No critical habitat for threatened or endangered species, as defined in the Endangered Species Act, exists on INEL (50 CFR 17.11 and 17.12).

The bald eagle and the peregrine falcon are the only Federally listed species that occur on INEL (Reynolds et al. 1986). Several bald eagles usually winter in the western and northern portions of INEL, 19 km or more from the NPR site. Peregrine falcons have been observed infrequently on the northern portion of INEL, 45 km from the NPR site. Neither bald eagles nor peregrine falcons have been observed on the NPR site or in areas suggested for associated facilities.

Six species that are candidates for listing by the Federal government (Category 2 species) regularly occur on INEL (Table G.4). Of these, only the ferruginous hawk and Swainson's hawk currently use the NPR site (Table 4.2.5-1). Both species forage over the area, and in 1990, the ferruginous hawk had an active nest in a juniper stand in the northeastern portion of the NPR site. The Townsend's western big-eared bat, which roosts in caves on INEL, has not been observed on the NPR site. Category 2 species do not receive legal protection under the Endangered Species Act, but the U.S. Fish and Wildlife Service (FWS) recommends that impacts to these species be considered in project planning since these species may become listed at any time.

The Idaho Department of Fish and Game maintains a list of rare, threatened, and endangered plant and animal species (Moseley and Groves 1990). *Oxytheca* is the only plant species on this list that occurs in the vicinity of the NPR site (Cholewa and Henderson 1984; Anderson, Glennon, and Houser 1990). Nine animal species on this list are present on INEL (Table G.4), but only the ferruginous hawk, Swainson's hawk, burrowing owl, and bobcat are known to utilize the NPR site. (The burrowing owl and bobcat use the site only occasionally.) The osprey and white-faced ibis currently do not use the NPR site because of the lack of aquatic habitats. Although these species of special concern do not receive legal protection, they are included here because of their regional importance.

#### 4.2.6 Cultural Resources

A total of 153 archaeological localities were identified during 1983-1984 and 1989-1991 surveys of the NPR site at INEL. The inventory includes prehistoric isolated artifacts, sites, and features representing a time span of about 8,000 years. Although some historic remains were encountered, no historic structures are present. Test excavations to determine National Register of Historic Places (NRHP) eligibility were initiated in 1989 and were completed in 1991. Consultations with potentially affected Native American groups, some of whom consider the area an ancestral homeland, have been initiated by DOE.

##### 4.2.6.1 Regional Prehistory, History, and Ethnography

The earliest known occupants of southeastern Idaho were big game hunters who hunted now-extinct mammals (e.g., mammoth) (ca. 12,000-7,500 years before present [B.P.]). During the middle prehistoric period (7,500-1,300 B.P.), generalized hunter-gatherer groups ranged widely across the region. The late prehistoric period (1,300-300 B.P.) was marked by full-scale adoption of the bow and arrow (Butler 1978, 1986). The first Euro-American settlers found the area inhabited by the Shoshone and Bannock tribes, whose life-styles, augmented by the horse, have been described in detail (Steward 1938; Murphy and Murphy 1986). Winter camps were reportedly scattered along major river drainages, while populations dispersed in the remaining seasons, probably moving across what is now the INEL area as they exploited a wide selection of locally available food resources (Ferris 1940).

The historic period (150-50 B.P.) began with infrequent visits by explorers and fur traders. By the early 1800s, some immigrants moved across the present INEL area as they traveled to the Oregon Territory via a northern spur of the Oregon Trail. In the 1860s, gold

TABLE 4.2.5-1 Threatened and Endangered Species and Species of Special Concern Known to Occur on the NPR Site on INEL

Species	Status <sup>a</sup>	
	Federal	State
Plants		
<i>Oxytheca</i>	NL	SC
Birds		
Ferruginous hawk	C2	SC
Swainson's hawk	C2	SC
Burrowing owl	NL	SC
Mammals		
Bobcat	NL	SC

<sup>a</sup>Status: NL = not listed; SC = species of special concern; C2 = Category 2 species.

Sources: Modified from Cholewa and Henderson 1984; Anderson, Glennon, and Houser 1990; Staley 1989.

From 1899 to 1980, 13 hurricanes were experienced in South Carolina and Georgia, for an average frequency of about one hurricane every 6 years. Three hurricanes were classified as major. Because SRS is about 160 km inland, the winds associated with hurricanes have usually diminished below hurricane force (greater than or equal to a sustained speed of 33.5 m/s).

### Atmospheric Dispersion Characteristics

Atmospheric dispersion improves as wind speed increases, stability conditions become more unstable, and the depth of the mixing layer increases. Annual and seasonal data on the frequency distribution of wind speed by wind direction and atmospheric stability class at SRS are summarized in Hoel (1983).

The approximate annual and seasonal morning and afternoon mixing-layer depths, as estimated by Holzworth (1972) for the SRS region, are listed in Table E.13.

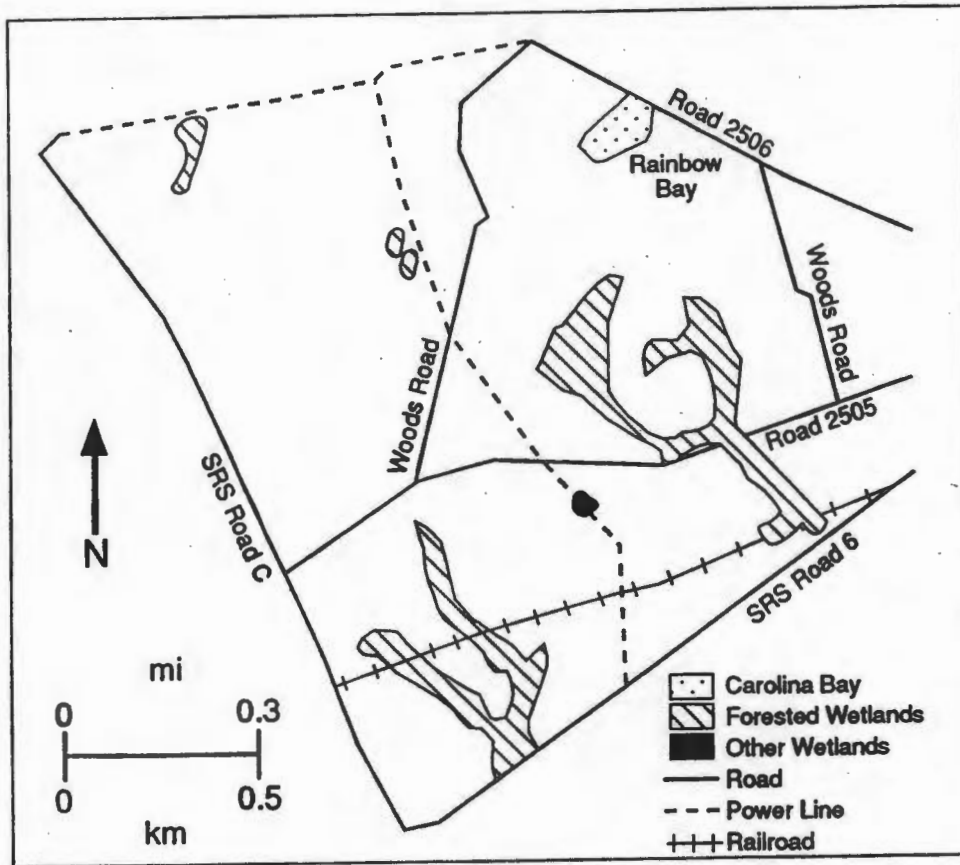
#### 4.3.2.2 Ambient Air Quality

The SRS is located near the center of the Augusta-Aiken Interstate Air Quality Control Region (AQCR). As of 1990, none of the areas within the SRS and its surrounding counties was designated as a nonattainment area with respect to any of the National Ambient Air Quality Standards (NAAQS) (40 CFR 81.341). The NAAQS and the ambient air quality standards for South Carolina and Georgia are listed in Table E.14. The state standards are identical to the NAAQS, except for the annual average total suspended particulate (TSP) concentration, for which an NAAQS no longer exists. The South Carolina Department of Health and Environmental Control (SCDHEC) also has ambient standards for gaseous fluorides (SCDHEC-3).

The major sources of criteria air pollutants at SRS are (1) the 13 coal-burning boilers for producing steam and electricity (A, D, H, K, and P areas); (2) fuel and target fabrication (M Area) and processing facilities (F and H areas); and (3) continuously operating diesel generators (F, H, K, L, and P areas). Other emissions include fugitive particulate emissions from coal piles and coal processing facilities, vehicular emissions, and temporary emissions from various construction-related activities. Conservative emission estimates for these sources are presented in Table E.15.

Since the promulgation of the Prevention of Significant Deterioration (PSD) regulations (40 CFR 52.21) in 1977, PSD permits have not been required for any of the new SRS emission sources or modifications to existing ones. In South Carolina, the only source in the Augusta-Aiken Interstate AQCR that has been issued a PSD permit is located near Orangeburg, about 65 km northeast of the nearest SRS boundary. Four sources in the Georgia portion of the AQCR have been issued PSD permits. The closest of these is approximately 16 km west of the nearest SRS boundary (Hunter 1989). Because of the substantial distances between these sources and the SRS boundary, it is expected that the PSD concentration increments used at the SRS boundary by these sources would be negligible (see Table E.4 for the maximum allowable PSD increments).

In 1988, SRS operated five on-site ambient air quality monitoring stations (Davis, Martin, and Todd 1989). Their locations and the pollutants they monitored are shown in Figure E.3.



**FIGURE 4.3.5-2 Wetlands on and Adjacent to the NPR Site at SRS (Sources: Banker 1989; NUS-6)**

Several wetlands are associated with intermittent tributaries to Pen Branch and Fourmile Branch. These wetlands are temporarily flooded bottomland hardwood forest and have a mature overstory of primarily deciduous trees, comprising such species as sweetgum, loblolly pine, black gum, and water oak. Red maple, greenbrier, wax myrtle, pepper vine, and poison ivy occur in the understory. Obligate wetland species occur in some areas of these wetlands and include royal fern, panic grass, button bush, and false loosestrife.

Isolated wetlands make up the remainder of the wetlands found on the NPR site. Rainbow Bay, a 1.74-ha Carolina Bay wetland that occurs in the northeastern portion of the site, supports a variety of amphibian species and has been the subject of a number of ecological studies (Semlitsch 1986; Wike et al. 1989). Sweetgum, black gum, and water oak fringe the open-water portions of this bay. Although generally flooded, Rainbow Bay does not contain standing water during periods of extended drought.

The rest of the isolated wetlands occurring on the site are upland depressional areas, but not any of these areas have standing water for long periods like Rainbow Bay. Most support deciduous trees such as sweetgum, water oak, willow oak, wax myrtle, loblolly pine, and red maple. The understory of these areas consists primarily of vines such as poison ivy, pepper vine, and greenbrier.

Another isolated wetland area, located along the powerline right-of-way and north of the C Line Railroad, has been disturbed by powerline construction and right-of-way maintenance activities (e.g., mowing). This area is dominated by invasive weedy species such as bush clover, sumac, blackberry, and poison ivy. While these plants do not meet the criterion for hydrophytic vegetation, hydric soils are present in this small depressional area.

Par Pond, which would receive NPR cooling tower blowdown effluents, supports a well-developed wetland community along its shores (Wike et al. 1989; Thiessen 1991). Water levels, which are maintained by makeup from the Savannah River, encourage development of wetland vegetation in the lake (Wike et al. 1989; DOE-10). The suitability of habitat in Par Pond for wetland vegetation is indicated by the extensive development of wetland vegetation in the lake and the spread of vegetation lakeward from the shores. These wetlands are in middle to late successional stages and are dominated by a variety of herbaceous macrophytes typical of the region (Wike et al. 1989). Common plant species in Par Pond wetlands include cattail, bullrush, pickerelweed, water lily, false nettle, and pennywort. The series of precooling ponds (Pond 2, Pond 5, and Pond C) through which NPR discharges would flow before entering the middle arm of Par Pond have undergone substantial recovery since P Reactor discharges were discontinued in 1988 (Thiessen 1991).

About 770 ha of wetlands occur in the floodplain of Fourmile Branch, the stream that would receive NPR sanitary wastewater discharges. Most of these wetlands (72%) are bottomland hardwoods (DOE-20). Before 1985, Fourmile Branch received heated water (up to 70°C) from C Reactor operations. This effluent produced water temperatures in excess of 60°C in Fourmile Branch downstream of the outfall. Because of these discharges, open water and marsh have replaced the original bottomland hardwood forest community. Tag alder and wax myrtle currently dominate riparian areas, and thick growths of emergent vegetation, such as sedges and cutgrass, dominate the marshlike area of the stream's delta within the Savannah River Swamp. Overall, approximately 60% of Fourmile Branch wetlands have been destroyed or modified by discharges of liquid effluents from C Reactor. Recovery of wetlands along this stream is being monitored by DOE.

#### 4.3.5.3 Aquatic Resources

Major aquatic habitat types that occur on SRS include small ponds, Carolina bays, reservoirs, streams, and the Savannah River (Figure 4.3.5-1). The surface areas of these waters vary from less than 0.4 ha to about 1,090 ha (Shields et al. 1982). The Savannah River and its associated swamp and tributaries exhibit a diverse fish fauna typical of other southeastern coastal plain rivers and streams (Bennett and McFarlane 1983). Aquatic habitat on the NPR site at SRS is limited to small intermittent streams and Rainbow Bay.

Aquatic vegetation is greatly reduced in SRS streams that have received thermal effluents (du Pont-1) because of the high water flows and elevated temperatures associated with reactor operations. Thermal gradients in these streams have ranged from 70°C (too hot for most organisms) to near ambient temperatures (8°C to 24°C) where the water enters the Savannah River. In the past, reactor effluent increased stream flows to between 10 and 20 times the normal flow. Such flows have broadened and eroded the streambeds, eliminated rooted aquatic plants and most of the trees along the stream, and caused deposition of silt along the bank and in the

### Impacts of NPR Construction and Operation

Construction of an HWR or MHTGR at Hanford would disturb about 804 ha or 463 ha of land, respectively, representing about 0.6% or 0.4% of the total area of the Hanford Site. Approximately 277 ha or 267 ha, respectively, would be occupied by facilities, access roads, or rights-of-way and, therefore, would remain developed for the life of the project. The remaining land would be revegetated with native grasses and shrubs upon completion of construction.

Because the existing WNP-1 facility would be used for an LWR at Hanford, development of this reactor and associated support facilities would disturb only about 118 ha, or 0.1% of the Hanford Site. About 51 ha of this land would remain developed for the life of the project; as with an HWR and MHTGR, the remaining land would be revegetated with native species.

Vegetation within construction areas would be destroyed during land-clearing activities. Plant species that are dominant on the Hanford NPR site, and thus would be most affected, include big sagebrush, cheatgrass, Sandberg's bluegrass, antelope bitterbrush, and needle-and-thread grass. Although the plant communities that would be disturbed are well-represented on the Hanford Site, they are relatively uncommon regionally because of the widespread conversion of shrub-steppe habitats to agriculture (Rickard and Poole 1989). Disturbed areas are generally recolonized by cheatgrass, a nonnative species, at the expense of native plants (Rickard and Poole 1989). Mitigation of these impacts could include minimizing the area of disturbance and revegetating with native species, including shrubs. Adverse impacts to vegetation on Hanford would be limited to the project area and vicinity and would not affect the viability of any plant populations on the Hanford Site.

Construction of an NPR and support facilities would have some adverse effects on animal populations. Less mobile animals such as invertebrates, reptiles, and small mammals within the project area would be destroyed during land-clearing activities. Larger mammals and birds in construction and adjacent areas would be disturbed by construction activities and would move to adjacent suitable habitat (Moore and Mills 1977), and these individual animals might not survive and reproduce. Project facilities would displace about 277 ha or 267 ha, respectively, of animal habitat for the life of an HWR or MHTGR; LWR facilities would displace about 51 ha of currently undisturbed animal habitat. Revegetated areas (e.g., construction laydown areas and buried pipeline routes) would be reinvaded by animal species from surrounding, undisturbed habitats. The adverse impacts of construction would be limited to the project area and vicinity and should not affect the viability of any animal populations on the Hanford Site because similar suitable habitat would remain abundant on the site.

Cooling tower drift would deposit salt on surrounding land areas and vegetation. For an HWR, LWR, or MHTGR, respectively, areas of approximately 7.1 ha, 12.7 ha, and 34.2 ha in the immediate vicinity of the cooling towers would be affected by salt deposition. These areas would experience salt deposition rates above the threshold value of 17.1 kg/ha/mo at which salt stress symptoms can become visible in sensitive plant species (DOE-20). Part of the locations affected by drift would include developed portions of the facility; thus, the actual total areas of vegetation affected would be less than the values cited above. The maximum distance from the cooling towers at which threshold values would be exceeded also would vary according to reactor technology – 350 m, 400 m, and 850 m for an HWR, LWR, and MHTGR, respectively. All areas affected by drift would be within the Hanford Site boundary and would be relatively small compared with the total land area of the Hanford Site. Studies conducted in 1987 for the

but these conditions also would be relatively temporary. The use of standard erosion control measures on the shore and banks of the river, including revegetation shortly after construction, would minimize erosion and subsequent increases in turbidity in the river. In addition, work in the river would be scheduled to avoid impacts to salmon reproduction and migration. The intake and discharge pipelines for an LWR have already been constructed; therefore, it is expected that there would be no additional impacts to aquatic organisms and habitats for LWR construction.

During operations, an HWR, LWR, or MHTGR would withdraw cooling water from the Columbia River at a rate representing less than 0.1% of the river's flow at the lowest regulated level (Section 5.2.2). Such removal would not significantly affect river flows or the aquatic organisms dependent on them.

Removal of cooling water from the Columbia River would cause the entrainment and subsequent mortality of planktonic organisms, including the eggs and larvae of certain fish species. Fish species in the Hanford Reach of the Columbia River that have planktonic egg and larval stages, and thus would be most affected by entrainment, include minnows, suckers, and mountain whitefish (NRC-1). Eggs and larvae of salmonid species are less likely to be entrained because they are not planktonic (Scott and Crossman 1973). It is not expected that free-swimming salmon fry (young fish) would be entrained because they typically occupy shallow, gravel areas near the stream bank (Scott and Crossman 1973; Dauble, Page, and Hanf 1989), away from the intake structure, which would be located more than 100 m from the shore at low water. Because a relatively small percentage of the total water volume passing the site (0.1% of the minimum flow) would enter the NPR intake, entrainment losses would not be expected to affect the viability of any populations of aquatic organisms in the Hanford Reach.

Larger fish in the immediate vicinity of the intake structure could be impinged and killed on the water intake screens, but monitoring associated with operation of WNP-2 at Hanford has detected only minimal loss of fish due to impingement. No impingement losses were detected in 1987 (WPPSS-3). Impingement losses due to an HWR or MHTGR would be minimized by the location of the intake structure (away from areas of fish concentration) and the low velocity (less than 15.2 cm/s) of water entering the structure. Intake structures for an HWR or MHTGR would be situated perpendicular to the river current, which flows at a minimum rate of 70.7 cm/s. Thus, fish and debris would tend to be washed away from the intake. The existing WNP-1 intake structure, which would be used for an LWR, consists of a perforated outer sleeve that would prevent fish from entering the system. The low intake velocity (12.2 cm/s) would reduce the likelihood of impingement losses (NRC-1).

An HWR, LWR, or MHTGR at Hanford would discharge cooling tower blowdown water into the Columbia River. These discharges would be similar to those from the existing WNP-2 facility at Hanford (see Section 5.2.2) and would be approximately 9.4 to 10.9°C warmer than the ambient water temperature in the river, which averages 11.4°C. On the basis of WNP-2 monitoring results (WPPSS-1; WPPSS-2; WPPSS-3), discharges of NPR blowdown water would be rapidly diluted and would not result in the development of a pronounced thermal or chemical plume in the river at any time of the year. For WNP-2, temperatures were within 0.7°C of the ambient river temperature at all monitoring stations downstream of the outfall. In addition, State of Washington standards for other measured water quality parameters were not exceeded. Impacts to aquatic organisms from NPR effluents would be limited to those organisms within the immediate vicinity of the outfall. Because the affected area would be so small, only a very small percentage of the biota in the Hanford Reach would be affected. It is

expected that relatively sessile organisms, such as benthic macroinvertebrates, would be most affected (NRC-1). Studies of chinook salmon and steelhead trout migrating past Hanford reactor discharge outfalls suggest that thermal discharges to the Columbia River would not adversely affect fish (Becker 1973). These studies have demonstrated that (1) the spawning run was unaffected by either on-shore or mid-river thermal discharges, (2) migration was unaffected when fish encountered warmer waters, and (3) salmonids were able to avoid areas with adverse temperatures and continue their migratory runs. On the basis of an extensive review of the literature, Langford (1990) has concluded that the migration of anadromous fish within rivers is not affected by thermal discharge as long as any discharge plumes stratify vertically or horizontally with sufficient space for fish to avoid adverse temperatures.

The cooling tower blowdown and other process effluents released to the Columbia River would contain radionuclides. The most abundant radionuclide in this effluent would be tritium (see Table H.2, Appendix H). Other radionuclides would be present in very small concentrations but would make a greater contribution to the total dose. The total dose from all radionuclides to an aquatic organism (e.g., a fish) living within undiluted effluent is estimated to be 1.2 mrad/d (405 mrad/yr) or less (Table 5.2.4-1). This value is well below the dose limit of 1,000 mrad/d established in DOE Order 5400.5 for the protection of native aquatic organisms. The calculated dose is conservative because it is unlikely that an organism would spend a substantial portion of its life within the effluent plume, and the concentration of radionuclides would be diluted by a factor of 4,200 upon release to the Columbia River (Section 5.2.2). Therefore, it is expected that the amount of radiation to which most river organisms would be exposed would be lower than this estimated dose, and, thus, impacts due to release of radionuclides to the river should not adversely affect aquatic biota.

### Mitigation and Conclusions

Detailed mitigation plans would be developed in consultation with the National Park Service of the Department of the Interior (per P.L. 100-605), the FWS, the COE, and the State of Washington as part of the permitting process for construction of HWR or MHTGR intake and discharge structures in the Columbia River. Standard erosion control practices on the shores and banks of the river, including revegetation with native species, could be implemented to minimize sediment runoff. In addition, construction activities could be scheduled to avoid impacts to salmon migration and reproduction. The use of the existing WNP-1 structures for an LWR would preclude the need to develop mitigation for construction.

Mitigation of operational impacts is related to the eventual design features of an NPR and associated facilities, as described in Section 3.4. This would include a commitment by DOE to meet all water quality standards at the point of discharge of blowdown effluents. The intake structures have been designed to

**TABLE 5.2.4-1 Calculated Dose to an Aquatic Organism Living in Undiluted Effluent from an NPR at Hanford<sup>a</sup>**

Source	Dose (mrad/d)	
	Contributed Dose	Total Dose (Existing + NPR)
Existing	0.006	NA
HWR	0.48	0.49
LWR	1.19	1.20
MHTGR	0.21	0.22

<sup>a</sup>Method of calculation is presented in Section 5.1.5.

### Impacts of NPR Construction and Operation

Construction of an NPR and support facilities at SRS would disturb about 214 ha for an HWR, 242 ha for an LWR, or 251 ha for an MHTGR. Each of these areas represents about 0.3% of the total land area of SRS. About 148 ha, 170 ha, or 163 ha for an HWR, LWR, or MHTGR, respectively, would be occupied by reactor facilities, access roads, rights-of-way, or other associated facilities and, therefore, would remain developed for the life of the project. The remaining land would be revegetated with native species after construction was completed.

Vegetation within construction areas would be destroyed during land-clearing activities. The plant communities that would be disturbed by development of an NPR (mostly pine plantation) are common on SRS. Because only 50 ha of the 125-ha NPR site would be occupied by NPR facilities, opportunity would exist to avoid less abundant habitats. Bottomland hardwood forest and deciduous forest could be avoided. Mitigation of impacts to plant communities could include minimizing the area of disturbance, and disturbed areas could be revegetated following completion of construction activities. It is expected that adverse impacts to vegetation related to the construction of NPR facilities on SRS would be limited to the project area and vicinity and would not affect the viability of any plant species on SRS.

Construction of an NPR would have some adverse effects on animal populations on SRS. Less mobile animals, such as invertebrates, reptiles, and small mammals, within the project area would be destroyed during land-clearing activities. Larger mammals and birds in construction and adjacent areas would be disturbed by construction activities and would move to adjacent suitable habitat (Moore and Mills 1977). Project facilities would displace 148-170 ha of wildlife habitat for the life of the project; 13 ha of this area would be maintained as mowed right-of-way, which would have some limited value for wildlife. Other disturbed areas (e.g., construction laydown areas and rights-of-way) would be revegetated upon completion of construction and would be reinvaded by animal species present in surrounding, undisturbed habitats. It is expected that the adverse impacts of construction would be limited to the project area and its immediate vicinity and would not affect the viability of any animal populations on SRS because similar suitable habitat would remain abundant at SRS.

Cooling tower drift would deposit salt on surrounding land areas and vegetation. For an LWR or MHTGR, approximately 5.4 ha or 0.4 ha in the immediate vicinity of the cooling towers would be affected by salt deposition, respectively. These areas would experience salt deposition rates above the threshold value of 17.1 kg/ha/mo at which salt stress symptoms can become visible in sensitive plant species (DOE-20). Estimated deposition rates for an HWR at SRS do not exceed this threshold. Part of the locations affected by drift from LWR or MHTGR cooling towers would include developed portions of the facility; thus, the actual total areas of vegetation affected would be less than the values cited above. The maximum distance from the cooling tower at which threshold values would be exceeded would be 300 m for an LWR and 100 m for an MHTGR. All areas affected by drift would be within the SRS boundary and would be relatively small compared with the total land area of the SRS. No cumulative effect from salt deposition by K Reactor and NPR would be expected because of the distance separating these facilities.

Very small concentrations of radionuclides (several orders of magnitude lower than natural background levels) would be released to the atmosphere from NPR operations. Studies have indicated that no other organisms are more sensitive than humans to radiation (NRC-8). Therefore, it is expected that as concluded for humans (Section 5.4.6), the effects of these releases on terrestrial organisms would be minor.

construction. Construction of water intake and discharge lines would disturb up to 1.76 ha of wetlands for each technology.

As discussed in Section 5.4.2.2, an MHTGR would require dewatering during construction of the underground reactor silos. These dewatering discharges would be released at the rate of  $0.06 \text{ m}^3/\text{s}$ . This discharge rate would be an order of magnitude below the current rate of discharge to Par Pond needed to maintain reservoir levels ( $0.8 \text{ m}^3/\text{s}$ ) and the average flow rate of Fourmile Branch. No impacts to wetlands would be expected if dewatering discharges were released to either of these aquatic systems. A permanent dewatering system that would be operable during MHTGR operations would discharge an estimated  $0.04 \text{ m}^3/\text{s}$ . As discussed in regard to construction, this level of discharge to either Par Pond or Fourmile Branch would not result in adverse impacts.

Operation of an NPR at SRS also has the potential to affect wetlands. Wetland impacts could occur through (1) the deposition of salts from cooling tower drift on wetland vegetation, (2) thermal effects resulting from the release of relatively warm cooling water blowdown to Par Pond or Fourmile Branch, and (3) the increase in water volume or flow rates resulting from discharges of blowdown water. As discussed in Section 5.4.4.1, the deposition of salts through NPR cooling tower drift would not be expected to affect vegetation for an HWR, even in areas of maximum deposition. This conclusion also applies to the effects of HWR drift on wetland vegetation. However, for an LWR or MHTGR, some areas in the immediate vicinity of the cooling towers would be affected by salt deposition. These areas would experience salt deposition rates above the threshold value of  $17.1 \text{ kg/ha/mo}$  at which salt stress symptoms can become visible in sensitive plant species (DOE-20). The maximum distance from the cooling tower at which threshold values would be exceeded would be 300 m for an LWR and 100 m for an MHTGR. Depending on the location of the cooling towers, wetlands adjacent to NPR facilities, including Rainbow Bay, could be affected by cooling tower drift.

If Fourmile Branch were used as the discharge point for NPR blowdown, the predicted maximum water temperature in the immediate discharge area of Fourmile Branch (end of C-Area discharge canal) would be  $28^\circ\text{C}$  (NUS-4). The water temperature would be at ambient levels within 2.5 km of the discharge point at all times of the year (NUS-4). No thermal impacts to wetlands along Fourmile Branch would be expected to result from the discharge of blowdown effluents because predicted temperatures are within the range of normal water temperatures in each season, and the predicted maximum temperature has been shown to have no adverse effect on production or survival of plants typical of SRS wetlands (du Pont-1).

Discharges of cooling tower blowdown effluent and water added to reduce effluent temperature during periods of reactor operations would increase the instream flow of Fourmile Branch from an average of  $0.93 \text{ m}^3/\text{s}$  to approximately  $2.0 \text{ m}^3/\text{s}$  for an HWR (see Section 5.4.2),  $2.4 \text{ m}^3/\text{s}$  for an LWR, or  $2.0 \text{ m}^3/\text{s}$  for an MHTGR. These values are considerably less than the instream flows in Fourmile Branch that occurred during operation of C Reactor ( $11 \text{ m}^3/\text{s}$ ) prior to 1985 (DOE-20), but would result in erosion of the streambed and disruption of the recovery of wetland vegetation that began after shutdown of C Reactor.

The potential impacts to wetlands resulting from release of blowdown and process effluents to Fourmile Branch have, in part, prompted the recommendation of Par Pond as the receiving waters for this effluent (Thiessen 1991) (see Section 3.3.5.8). With this option, effluents would be released to the P Reactor discharge facility, which consists of a series of precooling ponds (Pond 2, Pond 5, and Pond C) that flow into the middle arm of Par Pond. Thermal

impacts to Par Pond wetlands would not be expected because NPR cooling towers would be designed to meet the South Carolina requirements for thermal releases to Class B waters (maximum temperature of 32.2°C, maximum temperature rise of 2.8°C). Effluents from an NPR discharged at rates of 0.21 m<sup>3</sup>/s, 0.29 m<sup>3</sup>/s, or 0.22 m<sup>3</sup>/s for an HWR, LWR, or MHTGR, respectively, would reduce but not eliminate the need for makeup water from the Savannah River (Thiessen 1991). Makeup water currently is pumped at a rate of 0.8 m<sup>3</sup>/s to maintain the water level of Par Pond and minimum flows in Lower Three Runs Creek. On the basis of the ongoing need for makeup water, NPR operations would not adversely affect water levels in Par Pond or the wetlands dependent on these levels. The input of nutrients (phosphorous and nitrogen) associated with NPR effluents would result in some increase in aquatic macrophyte growth in the reservoir, but this increase would not be expected to have an adverse effect on wetland vegetation (Thiessen 1991).

With blowdown discharge going to Par Pond, Fourmile Branch would receive only treated sanitary wastewater at a maximum rate of 0.005 m<sup>3</sup>/s. This discharge rate would represent an increase of about 1% of average stream flow. Such an increase in flow would be expected to have a negligible effect on streambed erosion and would not be expected to adversely affect wetlands along the stream (Thiessen 1991). The input of nutrients to Fourmile Branch could result in some increase in the productivity of wetland vegetation along the stream, but this condition would not be expected to have adverse impact on the vegetation.

### Mitigation and Conclusions

With mitigation, most construction impacts to wetlands could be avoided. In keeping with DOE's policy of no net loss of wetlands, all wetlands on the NPR site would be avoided if possible. Detailed mitigation would be developed in consultation with the COE, the EPA, and the U.S. Fish and Wildlife Service (FWS) if construction activities could not be avoided within wetlands. Potential mitigation for lost wetlands includes replacement in kind. Standard erosion control practices, including revegetation of disturbed areas, would minimize the runoff of sediments to wetlands in the vicinity of construction areas. Mitigation of operational impacts to wetlands is related to design features of an NPR and its associated facilities, as described in Section 3.3.

During operations of an HWR, some salt would be deposited on wetland areas from cooling tower drift, but this deposition would not exceed acceptable levels. However, wetlands adjacent to LWR or MHTGR cooling towers could be adversely affected by drift. Rates of salt deposition resulting from cooling tower drift could be reduced to approximately half of those discussed by using a modern drift eliminator system (see Section 5.2.1). Such a system would reduce salt deposition rates below the levels at which adverse effects to vegetation would occur.

The effect on wetlands of releases of NPR blowdown and process effluents to Par Pond would be insignificant, except for a slight increase in productivity of aquatic macrophytes resulting from an input of nutrients. Effluents released to the reservoir would reduce, but not eliminate, the ongoing need for pumping makeup water from the Savannah River to maintain water levels in the pond. Maintaining water levels would ensure the long-term maintenance of wetland vegetation in Par Pond. The option of discharging blowdown effluents to Fourmile Branch would result in substantially greater impacts to wetlands. Discharge of only treated sanitary wastewater to Fourmile Branch during NPR operations would not adversely affect wetlands along the stream.

flow rate of the river ( $101 \text{ m}^3/\text{s}$ ). Discharge of cooling tower blowdown would compensate for some of this withdrawal. The net rate of withdrawal would not significantly affect river flow and therefore would not be expected to adversely affect the river ecosystem.

Withdrawal of water from the Savannah River would cause the entrainment and subsequent mortality of planktonic organisms, including the eggs and larvae of certain fish species (ichthyoplankton). Entrainment losses have been shown to be directly proportional to the amount of water withdrawn at SRS (DOE-10; DOE-20). The relationship between entrainment and water withdrawal was used to estimate entrainment losses associated with NPR operations (Table 5.4.4-1). Unlike the Fourmile Branch alternative, the discharge of NPR blowdown to Par Pond would greatly reduce the ongoing need for Par Pond makeup water and would not require additional withdrawals for temperature control. Thus, the Par Pond option has associated entrainment losses that are approximately half of those that would be incurred by discharging to Fourmile Branch. It is expected that the species entrained during NPR operations would be the same as those entrained in the past; thus, entrained larvae should be dominated by shad, crappie, and suckers, and entrained eggs should be predominantly those of the American shad and striped bass. As previously determined during monitoring of past SRS operations (Wike et al. 1989), fish populations would not be adversely affected by these losses.

Some larger fish would be impinged on the intake screen during water withdrawal. It is expected that bluespotted sunfish, threadfin shad, and gizzard shad, as in the past (Wike et al. 1989), would be the most common species impinged. Impingement losses also are proportional to water withdrawal rates at SRS (DOE-10; DOE-20); annual impingement losses due to NPR operations were calculated on the basis of this relationship (Table 5.4.4-1). As for entrainment losses, discharge to Par Pond has associated impingement losses that are approximately half of those that would be incurred by discharging to Fourmile Branch. The rate of impingement that would result from discharge to Par Pond is considered low relative to documented impingement rates for power plants in the southeastern United States (Wike et al. 1989).

If Fourmile Branch were used as the receiving waters for NPR blowdown effluents, the instream flow would increase by a factor of 2 to 3 (see Section 5.4.4.2). The flows associated with an NPR would not be of sufficient magnitude to prevent the habitation of the stream by native aquatic species, but would favor species that prefer swifter flows over those adapted to slower ones. Some resuspension of sediment would occur during initial start-up of an NPR, resulting in increased turbidity in the stream and some remobilization of cesium-137. However, observations made during restart of L Reactor indicate that this condition could be expected to cease within a few weeks of continued operation and not to adversely affect aquatic biota (du Pont-1). In contrast, discharge of blowdown effluent to Par Pond would have no adverse flow impacts, because the reservoir currently receives makeup water at rates that are greater than those that would occur during NPR operations. The NPR effluents would reduce the need for this makeup. Discharge of only sanitary wastewater to Fourmile Branch would be expected to have minimal effects on stream flow because this discharge ( $0.005 \text{ m}^3/\text{s}$ ) would represent less than 1% of the average flow.

The predicted maximum water temperature in the immediate discharge area, for either Par Pond or the Fourmile Branch, is  $28^\circ\text{C}$  (NUS-4). This temperature is below the maximum of  $32.2^\circ\text{C}$  required for Class B waters of the state. However, if cooling tower blowdown effluent were discharged to Fourmile Branch, the other temperature criterion for Class B waters (maximum temperature rise of  $2.8^\circ\text{C}$  within the mixing zone) would be exceeded for up to

TABLE 5.4.4-1 Estimated Annual Impingement and Entrainment Losses Related to NPR Operations at SRS<sup>a</sup>

Parameter	HWR	LWR	MHTGR
Discharge to Par Pond			
Number of fish impinged <sup>b</sup>	377 (470)	543 (551)	400 (483)
Number of fish larvae entrained ( $\times 10^6$ ) <sup>c</sup>	0.93 (1.16)	1.34 (1.36)	0.99 (1.19)
Number of fish eggs entrained ( $\times 10^6$ ) <sup>d</sup>	0.50 (0.62)	0.71 (0.73)	0.53 (0.64)
Percentage of total ichthyoplankton entrained <sup>e</sup>	0.49 (0.61)	0.70 (0.71)	0.51 (0.62)
Discharge to Fourmile Branch			
Number of fish impinged <sup>b</sup>	6.92 (982)	982 (1,271)	724 (1,014)
Number of fish larvae entrained ( $\times 10^6$ ) <sup>c</sup>	1.71 (2.43)	2.43 (3.14)	1.79 (2.51)
Number of fish eggs entrained ( $\times 10^6$ ) <sup>d</sup>	0.91 (1.29)	1.29 (1.67)	0.95 (1.33)
Percentage of total ichthyoplankton entrained <sup>e</sup>	0.89 (1.27)	1.26 (1.64)	0.93 (1.31)

<sup>a</sup>Numbers in parentheses represent total impingement or entrainment losses associated with Par Pond makeup withdrawals and simultaneous operation of an NPR.

<sup>b</sup>Estimated impingement losses based on a rate of  $1.15 \times 10^{-6}$  fish/m<sup>3</sup> calculated from Wike et al. (1989).

<sup>c</sup>Estimated entrainment losses based on rates of 0.0284 fish larvae/m<sup>3</sup> calculated from Wike et al. (1989).

<sup>d</sup>Estimated entrainment losses based on rates of 0.0151 fish eggs/m<sup>3</sup> calculated from Wike et al. (1989).

<sup>e</sup>Total ichthyoplankton passing SRS intakes estimated by Wike et al. (1989) at  $2.94 \times 10^8$ .

196 days during cooler months of the year (October to May). The mean monthly maximum temperature differential would be 7°C during January, and the water temperature would be at ambient levels within 2.5 km of the discharge point in Fourmile Branch at all times of the year (NUS-4). The exceedance would be in violation of the SRS NPDES permit and would require a Section 316(a) demonstration of a balanced biotic community after the NPR became operational. Since obtaining a variance to the permit cannot be assumed, use of Fourmile Branch would require that the cooling tower design be modified to lower discharge temperatures and meet existing standards.

Even at the point of discharge in either Par Pond or Fourmile Branch, water temperatures would be well below the thermal tolerance limits (mid to upper 30s°C) of native warmwater fish species, such as largemouth bass, bluegill, and channel catfish (Block et al. 1984; Cheetham et al. 1976; DOE-20). In addition, in each season, the temperature of the blowdown effluent would be within the range of normal water temperatures and would not be expected to affect the distribution or abundance of macroinvertebrates or other aquatic organisms within either Par Pond or Fourmile Branch. The rapid changes in temperature that could occur when the reactor was started up would not be expected to exceed the tolerance of fish species in either system (DOE-20; Cincotta, Stanffer, and Hocutt 1984). No thermal effects on aquatic biota in the Savannah River would be expected because the temperature of Fourmile Branch and Lower

### Impacts of NPR Construction and Operation

The bald eagle, wood stork, shortnose sturgeon, and American alligator are the only Federally listed species that could be affected by construction or operation of an NPR. Construction activities would not be expected to have direct impacts on any of these species because they have not been observed in the areas to be disturbed by construction. However, indirect effects could result from the runoff of sediment from construction areas and the disturbance of individual animals in the vicinity of construction. Only the bald eagle has been observed sufficiently close to the NPR site to be affected by runoff from the site. An active bald eagle nest is located about 7 km from the NPR site in an area of Pen Branch that drains the NPR site. If erosion was of sufficient magnitude, it could result in the buildup of sediment within the beaver pond on which the nest is located, and thus prompt the abandonment of the site by the eagles. This effect could be prevented by the implementation of standard erosion control methods during construction and the revegetation of disturbed sites upon completion of construction. It is not expected that bald eagles would be disturbed by construction activities. The NPR site is well outside (about 5.5 km) the buffer zone established by DOE to protect the bald eagle nest (Walker 1990). NPR operations would not be expected to affect this species.

NPR operations using Fourmile Branch to receive tower blowdown water would be the most likely source of impacts to the other Federally listed species (see Section 3.3.5.8 for a description of alternative discharge points at SRS). Two of these species (wood stork and alligator) have been observed in Fourmile Branch, and one (shortnose sturgeon) has been observed in the Savannah River, where cooling water would be withdrawn. As discussed in Sections 5.4.4.2 and 5.4.4.3, increased flows associated with the discharge of blowdown effluents to Fourmile Branch would impact wetlands and aquatic resources along the stream corridor. However, it is not expected that the wood stork and alligator, which occur in the Savannah River Swamp where Fourmile Branch empties, would be adversely affected.

The shortnose sturgeon would not be affected by thermal discharge to either Par Pond or Fourmile Branch because cooling tower blowdown water would be at the ambient temperature by the time it reached the Savannah River (NUS-4), where this species occurs. The finding of four shortnose sturgeon larvae in SRS water intake canals and the impingement of one Atlantic sturgeon (not a Federally listed species) raise the possibility that some entrainment and impingement loss of the shortnose sturgeon could occur as a result of NPR water withdrawals (Wike et al. 1989). Sturgeon eggs are not at risk of entrainment because they tend to sink and are strongly adhesive and gelatinous. These characteristics limit the downstream transport of eggs and dispersion through the water column (Wike et al. 1989; DOE-10; DOE-20). The low numbers of larvae in the vicinity of intake structures and the preference of these larvae for benthic habitats limit the possibility of entrainment at this life stage (Wike et al. 1989; DOE-10). The lack of evidence of past impingement or occupation of the intake canals by nonlarval forms of this species and the attainable swimming speeds of healthy juvenile and adult sturgeon relative to the velocity of water entering the intake structures make it unlikely that impingement losses could occur (Wike et al. 1989; DOE-20).

Several other species that do not receive Federal protection, but that are candidates for listing (Category 2), occur on SRS and have the potential to be affected by NPR construction. These include a number of plant species (cypress stump sedge, Elliott's croton, smooth purple coneflower, swamp lobelia, nestronia, and awned meadow-beauty), one fish (bighead redhorse), and one amphibian (Carolina crawfish frog).

participate in the review process. By interagency agreement with DOE, the U.S. Forest Service's Savannah River Forest Station manages the forested areas of SRS and is responsible for matters related to threatened and endangered species. The forest station projects more than \$2 million in revenues during 1990 from logging operations on SRS. Wetland and floodplain matters are managed through the Site Development and Utilization Plan process.

Land use patterns in the six-county region surrounding SRS are relatively stable, consisting of about 47% forest, 37% agriculture, 3% urban, and 3% wetland/water, with the remaining 10% used by SRS (NUS-1). The urban areas where SRS workers reside include the cities of Augusta, Georgia; Aiken, North Augusta, and Barnwell, South Carolina; and several smaller communities in the immediate area.

The area around SRS has a variety of public and private recreational facilities. Federal outdoor recreational facilities include portions of the Sumter National Forest, the Santee National Wildlife Refuge, and J. Strom Thurmond Lake. The six-county area contains five state parks, all of which offer water-based recreation, camping, hiking, and rental cabins or cottages. Generally, county and local parks are located in or near urban areas; most are associated with neighborhood schools. The area also contains public and private tennis courts, golf courses (including Augusta National), bowling centers, public and private swimming pools, and numerous campsites in state and Federal parks. Aiken County's private recreational facilities include 9 golf courses, 5 polo fields, and 3 equine training facilities.

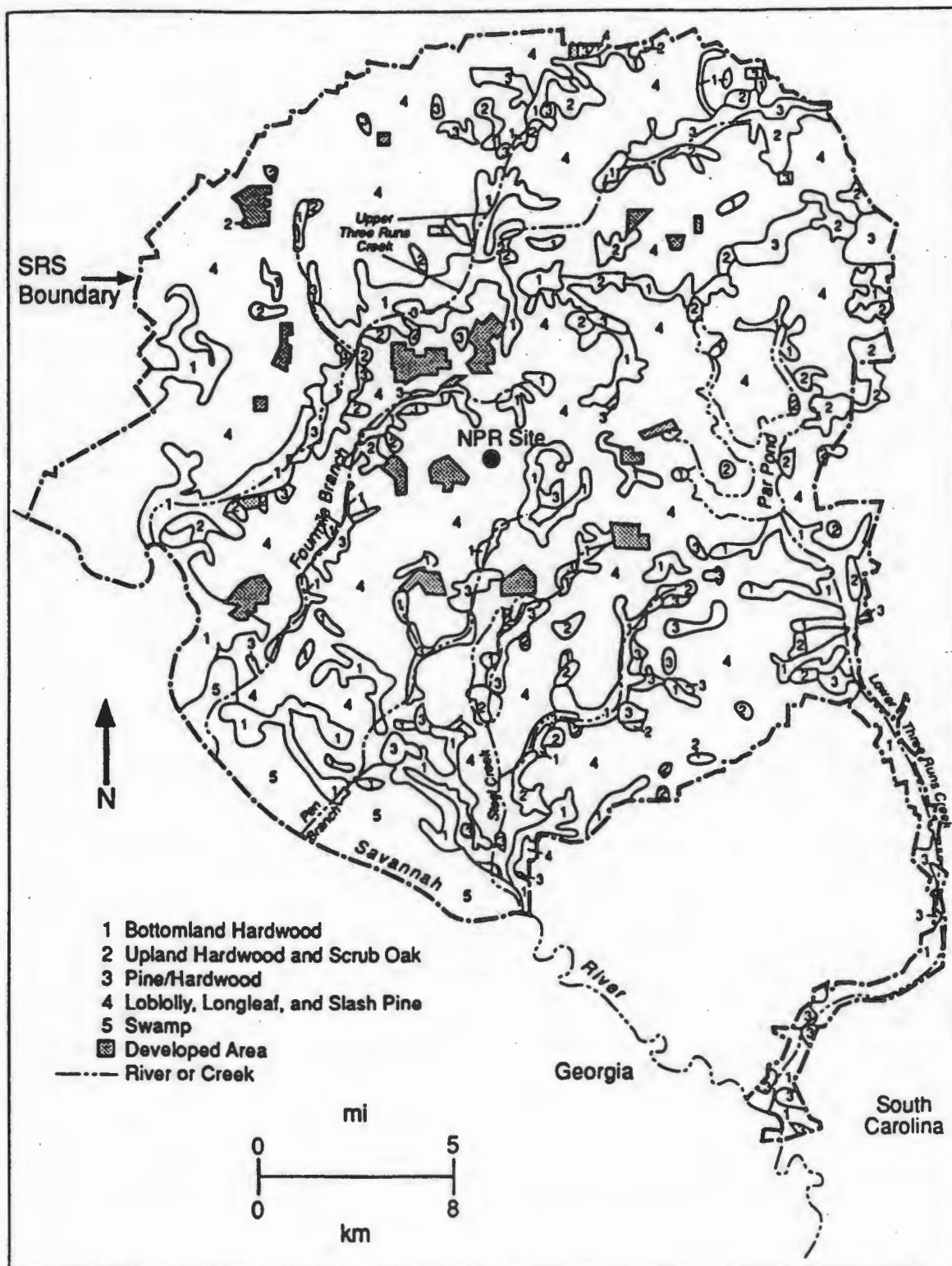
#### 4.3.5 Biotic Resources

This section describes the biotic resources of SRS, with emphasis on those components that could be affected by the construction and operation of an NPR. A more detailed description of these resources and lists of the common and scientific names of plant and animal species occurring there are presented in Appendix G, Section G.3. Additional descriptions of the ecology of SRS are provided by Dukes (1984) and Wike et al. (1989).

##### 4.3.5.1 Terrestrial Resources

The SRS was approximately one-third forested and two-thirds cropland when it was acquired by the Federal government in 1951. Today, about 90% of the site is forested as a result of natural succession and intensive forestry practices, with about 5% occupied by nuclear production and support facilities.

The SRS is in an area that divides two major forest associations -- the oak-hickory-pine forest and the southern mixed forest (Kuchler 1964). Consequently, species typical of both forest types occur on the site (DOE-9), and more than 1,300 species and varieties of vascular plants have been identified (Batson, Angerman, and Jones 1985). Common plant species are listed in Table G.5. Six major plant communities have been described for SRS (Figure 4.3.5-1) (Workman and McLeod 1990). Sandhill and upland hardwood communities dominated by oak and hickory are found in upland areas (Wike et al. 1989). On much of SRS, these communities have been displaced by pine plantations managed by the U.S. Forest Service. Bottomland hardwood forests are common in the moist soils along streams and are characterized by a more diverse plant community dominated by tulip poplar, birch, sweet gum, willow oak, water oak, and loblolly pine.



**FIGURE 4.3.5-1 Distribution of Major Plant Communities on SRS (Sources: McCort and Wein 1988; Workman and McLeod 1990)**

The diversity and abundance of wildlife on SRS reflect the interspersed and heterogeneity of the plant community of the site. Because of its mild climate and variety of aquatic and terrestrial habitats, SRS supports 43 amphibian, 51 reptile, 213 bird, and 48 mammal species (Wike et al. 1989). Common animal species are listed in Appendix G (Table G.5).

The SRS supports populations of game species, and DOE allows controlled hunts for white-tailed deer and feral hogs. Upland game birds, such as bobwhite and mourning dove, are common permanent residents of the site (Wike et al. 1989). Waterfowl occur mainly as winter migrants, although the wood duck is a common resident during the breeding season, especially within the Savannah River Swamp. From 11,000 to 17,000 ducks and coots winter on SRS; most congregate on Par Pond, L Lake, and on other large ponds and Carolina bays.

Reconnaissance surveys and analysis of aerial photographs indicate that pine plantations account for about 65% of the plant cover on the NPR site. These plantations are dominated by slash pine and loblolly pine ranging in age from new plantings to immature trees. Other vegetation types on the NPR site include old-field (17%), bottomland hardwood forest (9%), mixed forest (3%), upland deciduous forest (2%), grassland (maintained powerline right-of-way) (3%), and emergent wetland (<1%). The NPR site has not been surveyed to determine the relative abundance of plant and animal species within these habitats.

#### 4.3.5.2 Wetlands

The SRS contains approximately 17,400 ha of wetlands, most of which are associated with floodplains, streams, and impoundments (Wike et al. 1989). The most extensive wetland type on SRS is swamp forest associated with the Savannah River floodplain (Figure 4.3.5-1). These wetlands occupy approximately 3,800 ha on SRS and are dominated by bald cypress and water tupelo in areas that have not been affected by past discharges of cooling water effluent (Wike et al. 1989). Releases of cooling water effluent have caused several changes in plant communities of the swamp. These changes are discussed in greater detail in Wike et al. (1989) and are summarized in Section 4.3.5.3.

Approximately 190 Carolina bays occur on SRS (Shields et al. 1982; Schalles et al. 1989). Carolina bays are unique wetlands of the southeastern United States. These wetlands are natural shallow depressions, generally elliptical in shape, and are not associated with streams (Schalles et al. 1989). At SRS, they are located throughout upland areas, exhibit variable hydrologic regimes, and support a range of plant communities, from marsh to forested wetland (McCort and Wein 1988; Schalles et al. 1989).

In June 1991, field investigations were conducted to identify and delineate jurisdictional wetland areas on the NPR site. Color infrared photographs, existing soil surveys, and 7.5-minute U.S. Geological Survey topographic maps were used to locate potential wetlands before initiation of field work. The *Corps of Engineers Wetlands Delineation Manual* (COE-2) and the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (Federal Interagency Committee 1989) were used to make the jurisdictional determinations. Approximately 21 ha of jurisdictional wetlands were identified on the NPR site (Figure 4.3.5-2). Field review of identified wetlands, conducted in September 1991 using the criteria of the 1987 delineation manual, revealed no difference in wetlands delineation. Appendix S provides a more detailed description of wetlands on the NPR site. This information is summarized in the following paragraphs.

stream deltas. Streams that received thermal effluent exhibit markedly reduced macroinvertebrate and fish communities (in terms both of the number of species and the abundance of fish).

Par Pond, a 1,102-ha reactor cooling reservoir, would receive, via three tributary ponds, discharges of NPR cooling tower blowdown effluent. Par Pond was created in 1958 by damming Lower Three Runs Creek and was used to cool effluents from R Reactor and later for P Reactor. Without these reactors operating, water levels in Par Pond are maintained by pumping makeup water from the Savannah River at rates of 0.6-0.8 m<sup>3</sup>/s (Wike et al. 1989). Maintenance of water levels serves to protect aquatic resources in the reservoir and in Lower Three Runs below the Par Pond dam. The NPR effluents would flow through a series of precooling ponds (Pond 2, Pond 5, and Pond C) before entering the middle arm of Par Pond. The precooling ponds and connecting canal system have been affected by thermal discharges from P Reactor, but they have undergone substantial recovery since the reactor ceased operations in 1988 (Thiessen 1991).

Extensive studies have been conducted on the ecology of Par Pond; these studies are summarized and discussed in Wike et al. (1989). The reservoir has lush beds of floating and emergent macrophytes, particularly in the middle arm where NPR effluents would be discharged (Thiessen 1991). The abundance of macrophytes in this part of the pond have been attributed to past thermal releases and nutrient inputs related to P Reactor operations and have resulted in increased abundance of macroinvertebrates, zooplankton, and fish (Thiessen 1991). Phytoplankton, zooplankton, macroinvertebrate, and fish communities in Par Pond are, in general, similar to those in other southeastern lakes and indicate that Par Pond supports a balanced indigenous biological community (Wike et al. 1989). Fish species common to Par Pond include lake chubsucker, largemouth bass, bluegill, and black crappie (Wike et al. 1989).

Fourmile Branch, which would receive sanitary wastewater effluents from the NPR, is about 24 km long and drains an area of about 89 km<sup>2</sup>. Flows in the stream now average 0.93 m<sup>3</sup>/s (range of 0.28 to 9.3 m<sup>3</sup>/s) (Section 4.3.3). In its upper reaches, Fourmile Branch is a small blackwater stream that has been relatively unaffected by past SRS operations (Wike et al. 1989). Below its confluence with Castor Creek, Fourmile Branch is recovering following shutdown of C Reactor in 1985. Before that year, C Reactor discharged cooling water effluent to Fourmile Branch at a rate of 11 m<sup>3</sup>/s, with temperatures up to 70°C. These discharges changed the creek from a single-channel meandering stream to a wide, multichannel, braided stream system flowing within denuded floodplains (DOE-20). Discharges have reduced habitat diversity, macroinvertebrate abundance, macroinvertebrate diversity, fish abundance, and fish diversity (DOE-20). Sampling during periods of reactor shutdown indicated that mosquitofish were the most common fish species (97%) in the upper reaches of Fourmile Branch below the C Reactor outfall. Other species in this part of the stream included bowfin, sunfish, and mudminnows (DOE-20). Below the delta of the stream, a more diverse assemblage of fish was collected. That assemblage was dominated by gizzard shad and largemouth bass.

Fish have been entrained and impinged by the withdrawal of Savannah River water for SRS operations (Wike et al. 1989; DOE-20). Because of their presence in the water column, fish species that have planktonic eggs and larvae (ichthyoplankton) are most susceptible to entrainment losses. From 1983 to 1985, the amount of ichthyoplankton entrained by all SRS water intake structures ranged from 7.0% to 12.2% of the total estimated ichthyoplankton present in the portion of the Savannah River adjacent to SRS (DOE-10). Fish larvae entrained during this period were predominantly shad, crappie, and suckers (Wike et al. 1989). Eggs of the American shad and striped bass dominated entrainment samples and represented about 50% and 23% of the total eggs entrained, respectively. Despite these losses, egg and larval densities have not

exhibited a decline, indicating that populations have not been affected by entrainment (Wike et al. 1989). On the basis of the volume of withdrawals, annual entrainment losses associated with maintaining water levels in Par Pond are estimated to be approximately 716,000 fish larvae and 381,000 fish eggs. These entrainment losses represent about 0.4% of the total ichthyoplankton passing by SRS intakes in the Savannah River.

Larger fish are susceptible to impingement on intake screens during water withdrawals. Impingement losses were monitored from 1983 to 1985 at the three SRS intake structures, and average annual impingement was estimated at 7,600 fish (Wike et al. 1989). Bluespotted sunfish and threadfin shad were the most commonly impinged species. Other commonly impinged species included gizzard shad, redbreast sunfish, and warmouth. Annual impingement losses associated with maintaining water levels in Par Pond are estimated at 290 fish.

Sport and commercial fishing is not permitted on SRS. Species of commercial value that occur in the SRS Reach of the Savannah River are limited to the American shad, channel catfish, and Atlantic sturgeon (DOE-10). Sport fishermen are the most important consumers of fishes from the Savannah River, especially sunfish and crappie. The status of the Savannah River fishery is summarized in DOE-10.

#### 4.3.5.4 Threatened and Endangered Species

Federally and state-listed threatened and endangered species that occur on SRS and vicinity are listed and discussed in Appendix G, Section G.3 and Table G.6. Twenty-two of these species are known to occur in areas that could be affected by an NPR, and 15 more species could occur in these areas (Table 4.3.5-1). The remaining 30 species, including the Federally listed Piedmont bishop-weed, relict trillium, brother spike mussel, and peregrine falcon, have not been observed on the NPR site or affected areas, and, based on habitat requirements, are not likely to occur there. No critical habitat for threatened or endangered species, as defined in the Endangered Species Act, exists on SRS (50 CFR 17.11 and 17.12).


The bald eagle, wood stork, red-cockaded woodpecker, shortnose sturgeon, and American alligator are the only Federally listed species that could occur on the NPR site or affected areas (Knox and Sharitz 1990; Wike et al. 1989). Bald eagles (endangered) have been observed at several locations on SRS, particularly in the vicinity of Par Pond and L Lake and have nested annually near the south end of Par Pond since 1986 (Wike et al. 1989; NUS-6). An active bald eagle nest also is located about 7 km from the NPR site in an area of Pen Branch, which drains the NPR site. Wood storks (endangered) forage on SRS within the Savannah River Swamp and have been observed near the Fourmile Branch delta approximately 14 km from the NPR site (Wike et al. 1989; DOE-20). Sanitary wastewater from an NPR would be released to this area. American alligators (threatened) are common inhabitants of Par Pond, Beaver Dam Creek, and the Savannah River Swamp, all 8 km or more from the NPR site. No self-sustaining reproducing populations of the alligator have been observed in Fourmile Branch or its delta (DOE-20). Shortnose sturgeon spawn upstream of SRS, and four larvae of this species have been collected in or near the water intake canals on the Savannah River, 12 km from the NPR site (Wike et al. 1989). Entrainment or impingement of this species at SRS water intake structures has not been documented (Wike et al. 1989). Red-cockaded woodpeckers are found on SRS in scattered colonies (Wike et al. 1989). Areas occupied by these colonies contain mature (at least 60-year-old) pine trees that are used as nesting sites. Although some parts of the NPR site

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DOE/RW-0006, Rev. 8

# **Integrated Data Base for 1992: U.S. Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics**

October 1992

  
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Prepared by:

**Oak Ridge National Laboratory**  
Managed by Martin Marietta Energy Systems, Inc., for the  
U.S. Department of Energy under contract DE-AC05-84OR21400

Prepared for:

**U.S. Department of Energy**  
Office of Civilian Radioactive Waste Management  
Office of Environmental Restoration and Waste Management  
Washington, D.C. 20585



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# Environmental and Other Evaluations of Alternatives for Siting, Constructing, and Operating New Production Reactor Capacity

Volume 2: Appendices A-G

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U.S. Department of Energy  
Office of New Production Reactors



September 1992

## TRITIUM SUPPLY AND RECYCLING PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

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TABLE G.3 Partial List of Plant and Animal Species Found at INEL

Common Name	Scientific Name
<b>Plants</b>	
Juniper	<i>Juniperus</i> spp.
Cattail	<i>Typha latifolia</i>
Thickspike wheatgrass	<i>Agropyron dasystachyum</i>
Crested wheatgrass	<i>Agropyron desertorum</i>
Bluebunch wheatgrass	<i>Agropyron spicatum</i>
Cheatgrass	<i>Bromus tectorum</i>
Great Basin wild rye	<i>Elymus cinereus</i>
Wild barley	<i>Hordeum jubatum</i>
Indian ricegrass	<i>Oryzopsis hymenoides</i>
Bluegrass	<i>Poa</i> spp.
Bottle brush squirreltail grass	<i>Sitanion hystrix</i>
Needle-and-thread grass	<i>Stipa comata</i>
Sedge	<i>Carex</i> spp.
Nipple cactus	<i>Coryphantha missouriensis</i>
Spreading gilia	<i>Gilia polycladon</i>
Rush	<i>Juncus</i> spp.
Plains cottonwood	<i>Populus deltoides</i>
Willow	<i>Salix</i> spp.
Oxytheca	<i>Oxytheca dendroidea</i>
Shadscale saltbush	<i>Atriplex confertifolia</i>
Nuttall saltbush	<i>Atriplex nuttalli</i>
Winterfat	<i>Ceratoides lanata</i>
Plains milk-vetch	<i>Astragalus giviflorus</i>
Thistle milk-vetch	<i>Astragalus kentrophyta</i>
King's bladderpod	<i>Lesquerella kingii</i>
Phlox	<i>Phlox</i> spp.
Large-flowered gymnosteris	<i>Gymnosteris nudicaulis</i>
Phacelia	<i>Phacelia inconspicua</i>
Speedwell	<i>Veronica</i> spp.
Big sagebrush	<i>Artemisia tridentata</i>
Low sagebrush	<i>Artemisia arbuscula</i>
Rabbitbrush	<i>Chrysothamnus viscidiflorus</i>
Thistle	<i>Cirsium</i> spp.
Hawk's-beard	<i>Crepis</i> spp.
Wild lettuce	<i>Lactuca serriola</i>
Dandelion	<i>Taraxacum officinale</i>
Gray horsebrush	<i>Tetradymia canescens</i>
Yellow salsify	<i>Tragopogon dubius</i>
<b>Fish</b>	
Kokanee salmon	<i>Oncorhynchus nerka</i>
Rainbow trout	<i>Oncorhynchus mykiss</i>
Brook trout	<i>Salvelinus fontinalis</i>
Mountain whitefish	<i>Prosopium williamsoni</i>
Speckled dace	<i>Rhinichthys osculus</i>
Shorthead sculpin	<i>Cottus confusus</i>

U.S. Department of Energy  
Interim Mixed Waste Inventory Report:  
Waste Streams, Treatment Capacities  
and Technologies

DOE 1993 A



April 1993

Volume 1

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# U.S. Department of Energy Interim Mixed Waste Inventory Report Waste Streams, Treatment Capacities and Technologies



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Volume 2

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Volume 3



U.S. Department of Energy

# Environmental Restoration and Waste Management Five-Year Plan

Fiscal Years 1994-1998

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U.S. Department of Energy

# Environmental Restoration and Waste Management Five-Year Plan

Fiscal Years 1994-1998

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Volume 5

# **U.S. Department of Energy Interim Mixed Waste Inventory Report: Waste Streams, Treatment Capacities and Technologies**

- Volume I - Overview**
- Volume II - Site Specific-California through Idaho**
- Volume III - Site Specific-Illinois through New York**
- Volume IV - Site Specific-Ohio through South Carolina**
- Volume V - Site Specific-Tennessee through Washington**
- Volume VI - Appendices**

**April 1993**

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DOE/EA-0792

# Nonnuclear Consolidation Environmental Assessment

Volume I

Nuclear Weapons Complex  
Reconfiguration Program

Department of Energy  
Office of Defense Programs  
Deputy Assistant Secretary for Weapons Complex Reconfiguration

June 1993

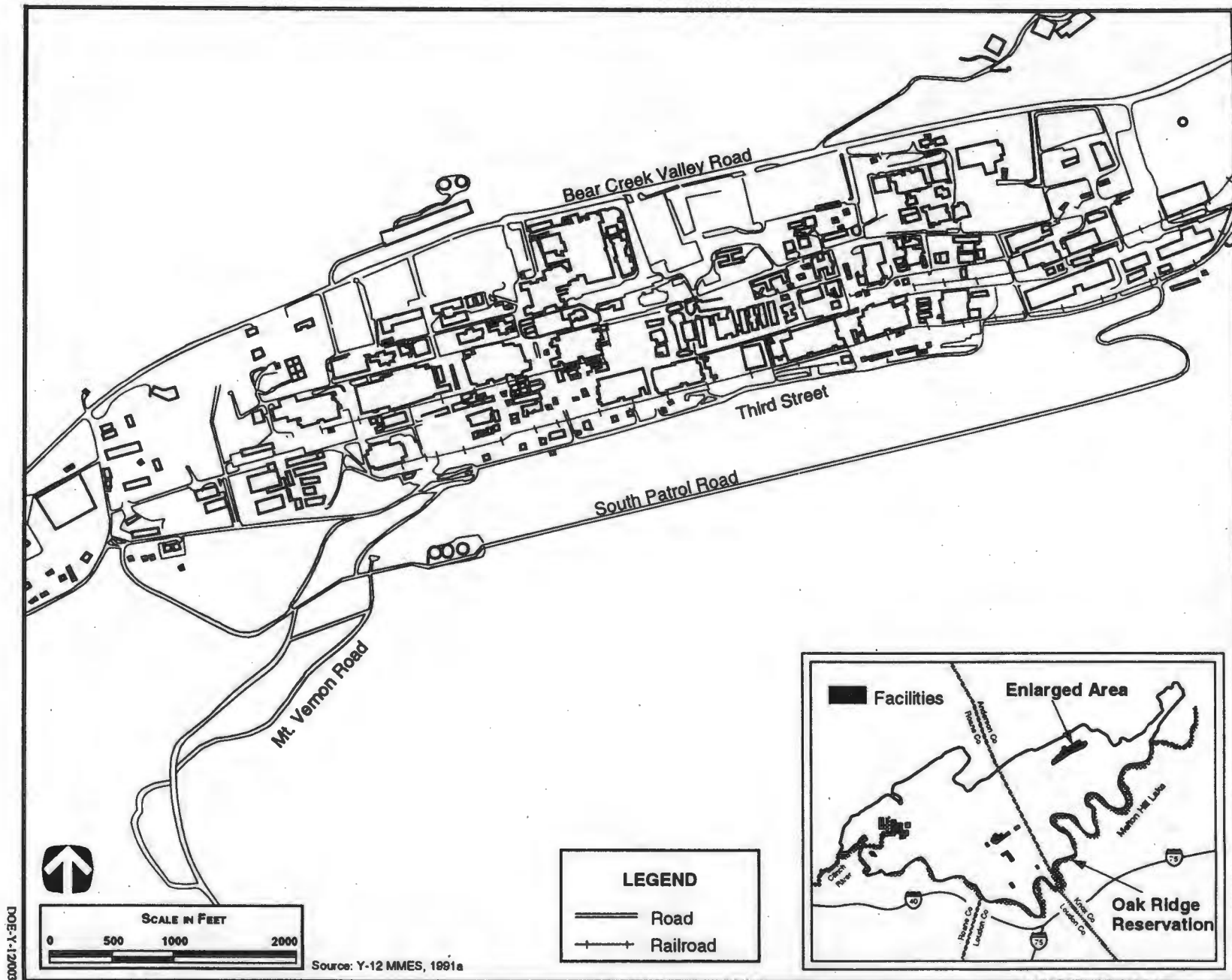


FIGURE 3.2.7-3.—Location of Facilities at the Oak Ridge Reservation, Y-12 Plant.

# Schlegel 4-12-94 COMPILATION OF DOSES TO WORKERS AT DOE FACILITIES IN 199

TOTAL EFFECTIVE DOSE

TABLE 2. Distribution of Whole-Body Ionizing Radiation Doses for DOE/DOE Contractor Employees and Visitors by Dose-Equivalent Interval, 1992

Dose-Equivalent Interval (rem)					***** Number of Persons *****			*** Collective Person-rem ***		
					Employees	Visitors	Total	Employees	Visitors	Total
< Measurable					85,804	9,695	95,499	0	0	0
0					22,059	4,697	26,756	587	97	685
<u>Worker doses</u>					3,587	270	3,857	550	43	593
<u>(max) Total Dose # avg dose</u>					1,240	151	1,391	426	54	479
<u>min Person rem workers min</u>					329	69	398	196	43	240
					155	55	210	133	48	180
① IVEL 1000' 75' 5,266 14.2					127	131	258	167	175	342
					21	1	22	51	3	54
② Pantex 1000' 51' 2,414 21.1					9	0	9	31	0	31
					6	0	6	28	0	28
					0	0	0	0	0	0
③ NTS 750' 2' 776 2.6					2	0	2	13	0	13
					1	0	1	8	0	8
					0	0	0	0	0	0
					0	1	1	0	10	10
④ ORR 2000' 68' 17,150 4.0					1	0	1	14	0	14
					113,341	15,070	128,411	2,205	472	2,677
⑤ SRS 3000' 349 19,541 17.9										
					350					

Page 2/10/94  
1992  
✓ Rem  
5/10/94  
⑥ Hanford 3,000' 258 9466 27.3  
⑦ RFP >10,000' 800' 6552 122

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# IMPLEMENTATION PLAN

for the

Department of Energy  
Programmatic Spent Nuclear Fuel Management

and

Idaho National Engineering Laboratory  
Environmental Restoration and  
Waste Management Programs

## ENVIRONMENTAL IMPACT STATEMENT

October 29, 1993

U.S. Department of Energy  
Idaho Operations Office



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# SPENT FUEL WORKING GROUP REPORT

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*on*  
INVENTORY AND STORAGE  
OF THE DEPARTMENT'S SPENT NUCLEAR FUEL  
*and other*  
REACTOR IRRADIATED NUCLEAR MATERIALS  
AND THEIR ENVIRONMENTAL,  
SAFETY AND HEALTH VULNERABILITIES



VOLUME I NOVEMBER 1993  
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## SPENT FUEL WORKING GROUP REPORT



*on*  
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VOLUME II NOVEMBER 1993  
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**SPENT FUEL INITIATIVE**

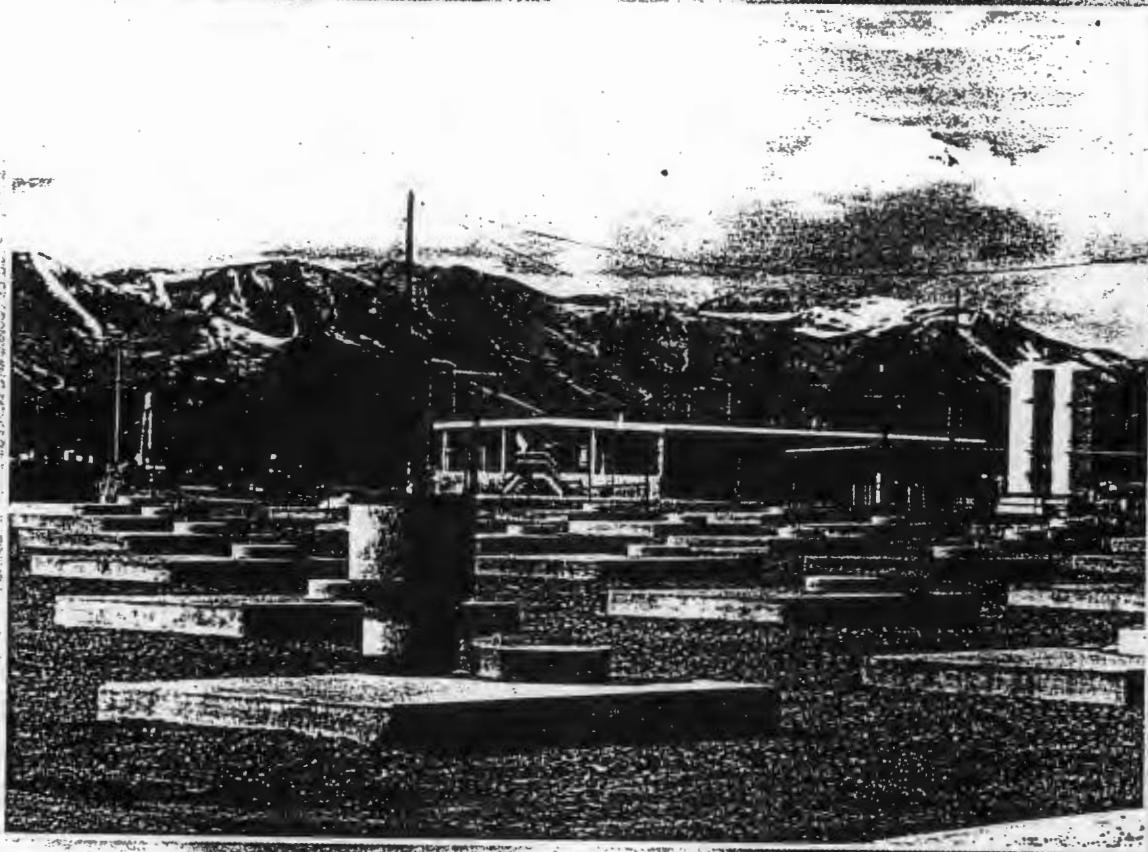
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**WORKING GROUP ASSESSMENT TEAM REPORTS  
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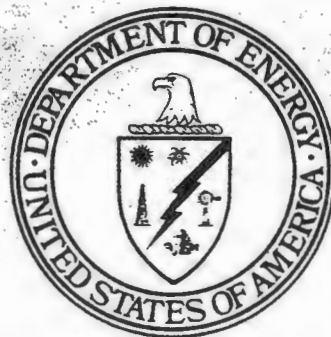


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# SPENT FUEL WORKING GROUP REPORT



on  
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OF THE DEPARTMENT'S SPENT NUCLEAR FUEL  
*and other*  
REACTOR IRRADIATED NUCLEAR MATERIALS  
AND THEIR ENVIRONMENTAL,  
SAFETY AND HEALTH VULNERABILITIES



VOLUME III NOVEMBER 1993  
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# FEDERAL ENVIRONMENTAL STANDARDS OF POTENTIAL IMPORTANCE TO OPERATIONS AND ACTIVITIES AT U.S. DEPARTMENT OF ENERGY SITES

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DRAFT

JUNE 1993

Prepared for:  
U.S. Department of Energy  
Assistant Secretary for  
Environment, Safety and Health

Office of Environmental Guidance  
Air, Water and Radiation Division

Under Contract No. AC06-76RL01830



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DOE/EA-0841

ENVIRONMENTAL ASSESSMENT OF THE IMPORT  
OF RUSSIAN PLUTONIUM-238



June 1993

U.S. Department of Energy

Office of Nuclear Energy

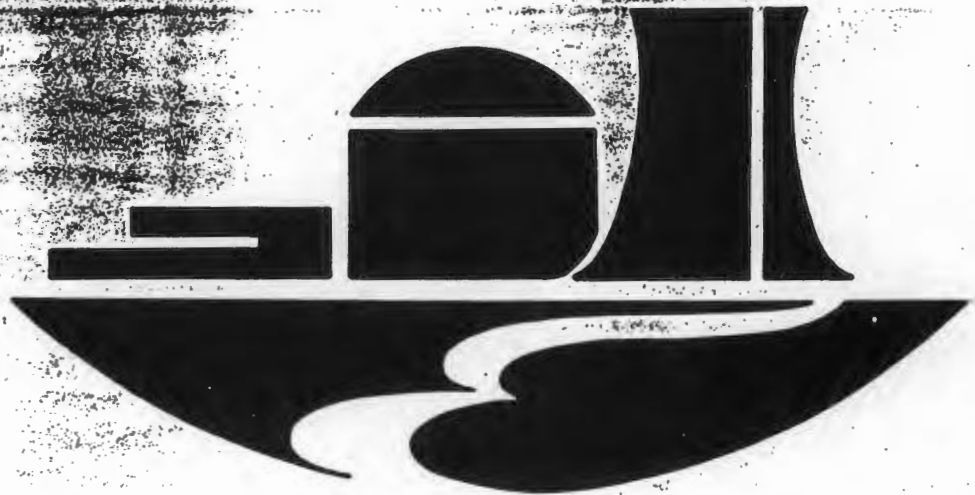
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DOE/RW-0006, Rev. 9

# **Integrated Data Base for 1993: U.S. Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics**

March 1994



Prepared by

**Oak Ridge National Laboratory**  
Managed by Martin Marietta Energy Systems, Inc., for the  
U.S. Department of Energy under contract DE-AC05-84OR21400

Prepared for

**U.S. Department of Energy**  
Office of Civilian Radioactive Waste Management  
Office of Environmental Restoration and Waste Management  
Washington, D.C. 20585



## PREFACE

The information in this report summarizes the U.S. Department of Energy (DOE) data base for inventories, projections, and characteristics of domestic spent nuclear fuel and radioactive waste. This report is updated annually to keep abreast of continual waste inventory and projection changes in both government and commercial sectors. Baseline information is provided for planning purposes and to support program decisions. Although the primary purpose of this document is to provide background information for program planning within the DOE community, it has also been found useful by state and local governments, the academic community, and a number of private citizens. To sustain the objectives of this program in providing accurate and complete data in this field of operation, comments and suggestions to improve the quality and coverage are encouraged. Such comments and any general inquiries should be directed to the U.S. Department of Energy at either of the following:

Office of Civilian Radioactive Waste Management  
Route Symbol RW-432  
1000 Independence Avenue, SW  
Washington, DC 20585-0001

Office of Environmental Restoration and Waste  
Management  
Route Symbol EM-351 or 433  
Trevion 2  
Washington, DC 20585-0002

This report was prepared by the Integrated Data Base Program, which is jointly sponsored by the DOE Office of Civilian Radioactive Waste Management and the DOE Office of Environmental Restoration and Waste Management. Suggestions, questions, and requests for information may be directed to any of the following:

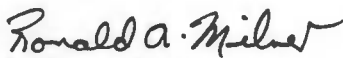
M. L. Payton, DOE/RW-432, Washington, DC 20585-0001  
Telephone: (202) 586-9867


J. T. Williams, DOE/EM-351, Washington, DC 20585-0002  
Telephone: (301) 903-7179

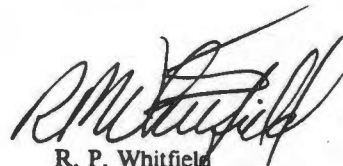
M. Tolbert-Smith, DOE/EM-433, Washington, DC 20585-0002  
Telephone: (301) 903-8121

J. A. Klein, ORNL, P.O. Box 2008, Oak Ridge, TN 37831-6495  
Telephone: (615) 574-6823

An important part of the Integrated Data Base Program is the Steering Committee, whose members provide both generic guidance and technical input. The membership of this committee, shown on the following page, represents all of the major DOE sites and programs for spent fuel and radioactive waste management. Each support committee member is assisted by a technical liaison as needed. The participation and assistance of these individuals are acknowledged with appreciation.

  
Ronald A. Milner  
Associate Director  
Office of Storage and Transportation  
Office of Civilian Radioactive  
Waste Management

  
Jill E. Lytle  
Deputy Assistant Secretary  
Office of Waste Management  
Office of Environmental Restoration  
and Waste Management

  
R. P. Whitfield  
Deputy Assistant Secretary  
Office of Environmental Restoration  
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and Waste Management

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Draft Environmental Impact Statement**

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Appendix B**

**Idaho National Engineering Laboratory  
Spent Nuclear Fuel Management Program**



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**Volume 2  
Part A**

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Office of Environmental Management  
Idaho Operations Office

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## COVER SHEET

**RESPONSIBLE AGENCIES:** Lead Federal Agency: U.S. Department of Energy  
Cooperating Federal Agency: U.S. Department of the Navy

**TITLE:** Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Draft Environmental Impact Statement.

**CONTACT:** For further information on this Environmental Impact Statement call or contact:

Public Comments on the SNF and INEL EIS  
Attention: Tom Wichmann  
DOE Idaho Operations Office  
P.O. Box 3189  
Idaho Falls, ID 83403-3189  
[REDACTED]

For general information on the U.S. Department of Energy NEPA process call 1-800-472-2756 to leave a message or contact:

Carol Borgstrom, Director  
Office of NEPA Oversight (EH-25)  
U.S. Department of Energy  
1000 Independence Avenue, SW  
Washington, D.C. 20585  
[REDACTED]

**ABSTRACT:** This document analyzes at a programmatic level the potential environmental consequences over the next 40 years of alternatives related to the transportation, receipt, processing, and storage of spent nuclear fuel under the responsibility of the U.S. Department of Energy. It also analyzes the site-specific consequences of the Idaho National Engineering Laboratory sitewide actions anticipated over the next 10 years for waste and spent nuclear fuel management and environmental restoration. For programmatic spent nuclear fuel management, this document analyzes alternatives of no action, decentralization, regionalization, centralization and the use of the plans that existed in 1992/1993 for the management of these materials. For the Idaho National Engineering Laboratory, this document analyzes alternatives of no action, ten-year plan, minimum and maximum treatment, storage, and disposal of U.S. Department of Energy wastes.

**PUBLIC COMMENTS:** Public meetings on the Draft Environmental Impact Statement will be announced in June 1994. Written and oral comments on the Draft Environmental Impact Statement will be accepted until September 30, 1994, at the Idaho address and telephone number provided above. The U.S. Department of Energy will consider these public comments in preparing the Final Environmental Impact Statement.

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**Volume 1  
Appendix F**

**Nevada Test Site and Oak Ridge Reservation  
Spent Nuclear Fuel Management Programs**



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**Department of Energy Programmatic  
Spent Nuclear Fuel Management  
and  
Idaho National Engineering Laboratory  
Environmental Restoration and  
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Draft Environmental Impact Statement**

**Volume 1  
Appendix A**

**Hanford Site  
Spent Nuclear Fuel Management Program**



**June 1994**

**DOE 1994s**

DOE/RL-94-68

UC-722

# **User's Guide for Shipping Type B Quantities of Radioactive and Fissile Material, Including Plutonium, in DOT-6M Specification Packaging Configurations**

**D. L. Kelly**

Date Published  
**September 1994**

Prepared for the U.S. Department of Energy  
Transportation Management Division  
Office of Environmental Management



**United States  
Department of Energy**

P.O. Box 550  
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March 23, 1995

Mr. Johnnie Grant

Tetra Tech, Inc.

4700 [REDACTED] 190

Alexandria, VA 22302

Mr. Grant

Enclosed is a copy of the report you had request from the Shipment Mobility / Accountability Collection (SMAC) system for work on the Tritium Supply and Recycling Programmatic Environmental Impact Statement. The report is a detailed listing Hazardous Waste Manifest shipments information containing information on the TSD facility, Proper Shipping Name and additional descriptions for each site you specified. Because a commodity on a Hazardous Waste Manifest may have no additional descriptions or multiple additional descriptions sum of the "Number of Shipments Containing this description" column and the "Quantity" column may not be equal to the total for the Proper Shipping Name. If you have any questions about how to interpret this report please give me a call at [REDACTED]

Sincerely,

Science Applications International Corporation

A handwritten signature in black ink, appearing to read "Andrew L. Dixon". The signature is fluid and cursive, with a large, stylized "A" and "D".

Andrew L. Dixon

Enclosure

**Department of Energy Programmatic  
Spent Nuclear Fuel Management  
and  
Idaho National Engineering Laboratory  
Environmental Restoration and  
Waste Management Programs  
Final Environmental Impact Statement**

**Volume 1  
Appendix B**

**Idaho National Engineering Laboratory  
Spent Nuclear Fuel Management Program**



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DOE/EIS-0203-F

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Spent Nuclear Fuel Management  
and  
Idaho National Engineering Laboratory  
Environmental Restoration and  
Waste Management Programs  
Final Environmental Impact Statement**

**Volume 1  
Appendix A**

**Hanford Site  
Spent Nuclear Fuel Management Program**



**April 1995**

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**Department of Energy Programmatic  
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Environmental Restoration and  
Waste Management Programs  
Final Environmental Impact Statement**

**Volume 1  
Appendix C**

**Savannah River Site  
Spent Nuclear Fuel Management Program**



**April 1995**

**U.S. Department of Energy  
Office of Environmental Management  
Idaho Operations Office**

DOE 19953

DOE/EIS-0218D  
March 1995

Volume 1

DOE 19955

# DRAFT ENVIRONMENTAL IMPACT STATEMENT

*on a*

Proposed Nuclear Weapons Nonproliferation  
Policy Concerning Foreign Research Reactor  
Spent Nuclear Fuel



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United States Department of Energy  
Assistant Secretary for Environmental Management  
Washington, DC 20585

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Volume 1

# DRAFT ENVIRONMENTAL IMPACT STATEMENT

*on a*

Proposed Nuclear Weapons Nonproliferation  
Policy Concerning Foreign Research Reactor  
Spent Nuclear Fuel



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United States Department of Energy  
Assistant Secretary for Environmental Management  
Washington, DC 20585

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DOE 1995t

DOE/EIS-0218D  
March 1995

Volume 2

# DRAFT ENVIRONMENTAL IMPACT STATEMENT

*on a*

Proposed Nuclear Weapons Nonproliferation  
Policy Concerning Foreign Research Reactor  
Spent Nuclear Fuel

## **Appendix A** **Environmental Justice Analysis**



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United States Department of Energy  
Assistant Secretary for Environmental Management  
Washington, DC 20585

---

Copies are available (while supplies last) from:  
Office of Spent Fuel Management (EM-37)  
Office of Environmental Management  
United States Department of Energy  
1000 Independence Avenue, SW  
Washington, DC 20585



**Department of Energy Programmatic  
Spent Nuclear Fuel Management  
and  
Idaho National Engineering Laboratory  
Environmental Restoration and  
Waste Management Programs  
Final Environmental Impact Statement**

**Volume 2  
Part A**



**April 1995**

**U.S. Department of Energy  
Office of Environmental Management  
Idaho Operations Office**

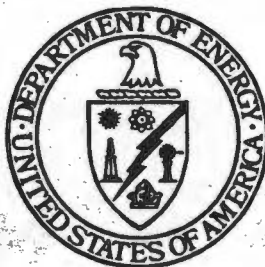
**DOE 1995W**

DOE/EIS-0203-F

**Department of Energy Programmatic  
Spent Nuclear Fuel Management  
and  
Idaho National Engineering Laboratory  
Environmental Restoration and  
Waste Management Programs  
Final Environmental Impact Statement**

**Volume 1  
Appendix F**

**Nevada Test Site and Oak Ridge Reservation  
Spent Nuclear Fuel Management Programs**



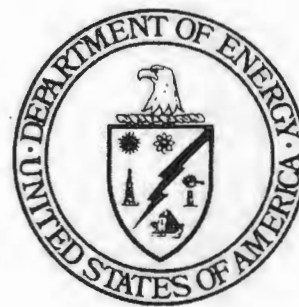
**April 1995**

**U.S. Department of Energy  
Office of Environmental Management  
Idaho Operations Office**

# Volume I

# Draft Waste Management Programmatic Environmental Impact Statement

## Volume I of IV



DOE/EIS-0200-D



August 1995

## **COVER SHEET**

**Lead Agency:** U.S. Department of Energy  
**Cooperating Agencies:** U.S. Environmental Protection Agency

### **Title:**

Waste Management Draft Programmatic Environmental Impact Statement

### **Contact:**

For further information about this Programmatic Environmental Impact Statement, contact:

David Hoel, WM PEIS Project Manager  
Office of the Assistant Secretary for Environmental Management  
U.S. Department of Energy (EM-37)  
1000 Independence Avenue, SW  
Washington, DC 20585  
(202) 586-3977 or leave a message at (800) 736-3282

For general information on the Department of Energy's process for implementing the National Environmental Policy Act, contact:

Carol Borgstrom, Director  
Office of NEPA Policy and Assistance  
Office of the Assistant Secretary for Environment, Safety and Health  
U.S. Department of Energy (EH-42)  
1000 Independence Avenue, SW  
Washington, DC 20585  
(202) 586-4600 or leave a message at (800) 472-2756



Office of  
Fissile Materials Disposition

United States Department of Energy

Disposition of Surplus  
Highly Enriched Uranium  
Draft Environmental  
Impact Statement

October 1995

For Further Information Contact:

U.S. Department of Energy

Office of Fissile Materials Disposition, 1000 Independence Ave., SW, Washington, D.C. 20585

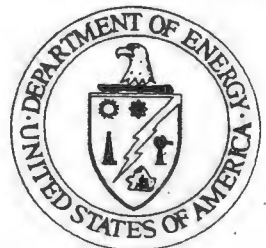
**DOE 1995mm**



# **BEYOND DESIGN BASIS ACCIDENT ANALYSIS**

**REVISION A  
AUGUST 1995**

**Office of Fissile Materials  
Disposition**





# OPENNES

**Press Conference**

**Fact Sheets**

**February 6, 1996**

DOE 1996c

# DOE

# FACTS

## DECLASSIFICATION OF THE UNITED STATES PLUTONIUM INVENTORY AND RELEASE OF REPORT, "PLUTONIUM: THE FIRST 50 YEARS"

The Department of Energy has declassified the United States plutonium inventory and other information needed to present a complete picture of the production, acquisition, and use of plutonium from 1945 through September 30, 1994. The Secretary of Energy's commitment of June 27, 1994, to inform the public about the details of the United States plutonium story is met by release today of a comprehensive report, "Plutonium: The First 50 Years."

### SPECIFICALLY:

- The total United States Government plutonium inventory is 99.5 metric tons, which includes plutonium at the Department of Energy sites and plutonium in the nuclear weapons stockpile under custody of the Department of Defense. The locations of the inventory are shown in an attached map. For unclassified reporting, all plutonium in the Department of Defense custody is added to the Pantex Site total.
- The total plutonium removed from the United States inventory is 12.0 metric tons:
  - Expended in nuclear tests                      3.4 metric tons
  - Inventory differences                              2.8 metric tons
  - Waste (normal operating losses)                      3.4 metric tons

(More)

U.S. Department of Energy  
Office of Congressional, Public,  
and Intergovernmental Affairs  
Media Contact: Barbara Wetherell  
(202) 586-5806

U.S. Department of Energy  
Office of Nonproliferation and  
National Security  
Program Contact: A. Bryan Siebert  
(301) 903-3521

- Fission and transmutation            1.2 metric tons
  - Decay                                    0.4 metric tons
  - Domestic transfers                    0.1 metric tons
  - Foreign transfers                    0.7 metric tons
- A majority of the United States plutonium (85 percent) is weapon-grade, which is predominately Pu<sup>239</sup> with less than 7 percent Pu<sup>240</sup> by weight and a small amount of heavier plutonium isotopes.
- Production and acquisition of plutonium amounted to:
- Savannah River Site and Hanford Site production reactors            103.4 metric tons
  - Research reactors                    0.6 metric tons
  - Domestic sources                    1.7 metric tons
  - Foreign countries                    5.7 metric tons
- Total                                    111.4 metric tons

The total production and acquisition of plutonium is equal to the current total inventory plus the total removals.

- An attached map shows the locations and quantities of the plutonium in waste. Most of the plutonium was removed from the inventories as normal operating losses. However, not all plutonium in waste is necessarily derived from normal operating losses.

#### BACKGROUND:

- In a previous announcement on December 7, 1993, the Department of Energy revealed its inventories of plutonium, excluding the Pantex Site. Today's announcement includes all of the Department of Energy's sites as well as plutonium in the nuclear weapons stockpile under the custody of the Department of Defense.
- Plutonium was produced from 1945 through 1994 to support the United States nuclear weapons, nuclear energy, and reactor development programs.
- The quantities listed are based on the available records, some of which are very old. The quantities may be updated after reevaluation of the original records.

(More)

- Similar information is planned for future release on highly enriched uranium in approximately 1 year.

BENEFITS:

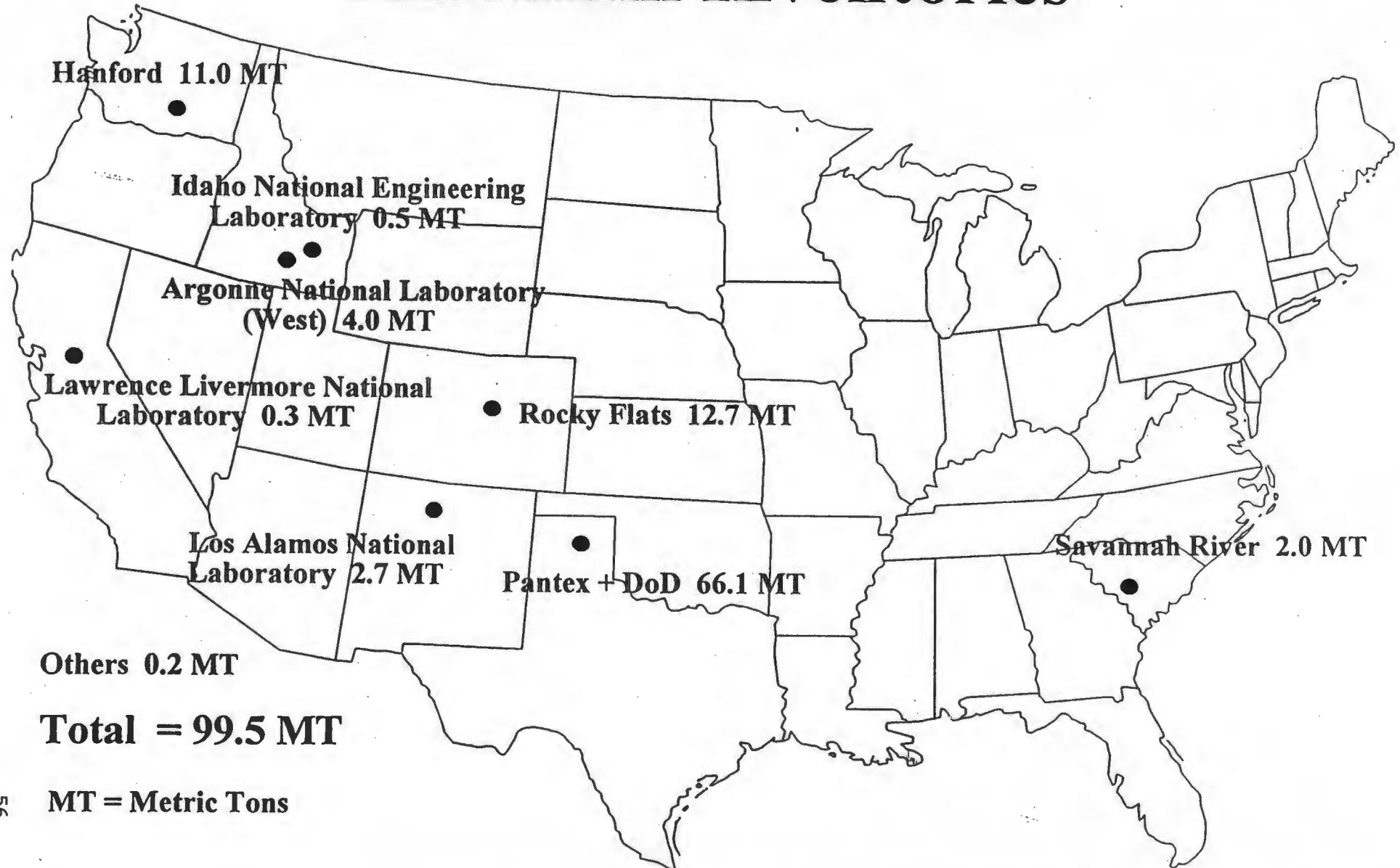
- As part of its Openness Initiative, the Department of Energy is declassifying information regarding the Government's plutonium inventory and all remaining information on its production, acquisition, and use of plutonium. As a result of this declassification, the American public will have information that is important in consideration of the proper management and ultimate disposition of the plutonium stockpile.
- Openness encourages informed public debate on plutonium management including safety, security, and storage.
- The release of this information should encourage other nations to declassify similar information.
- The data will be of some aid to regulators who oversee environmental health and safety activities.
- The data will permit more environmental related information to be provided to stakeholders and to the public.
- The data will provide valuable nonproliferation benefits by making potential International Atomic Energy Agency safeguards arrangements easier to implement.
- Declassification of the information promotes Government accountability and trust in Government by the public.
- By declassification, the United States Government is acting as a global leader in nuclear information transparency.

WHO ARE THE KEY STAKEHOLDERS?:

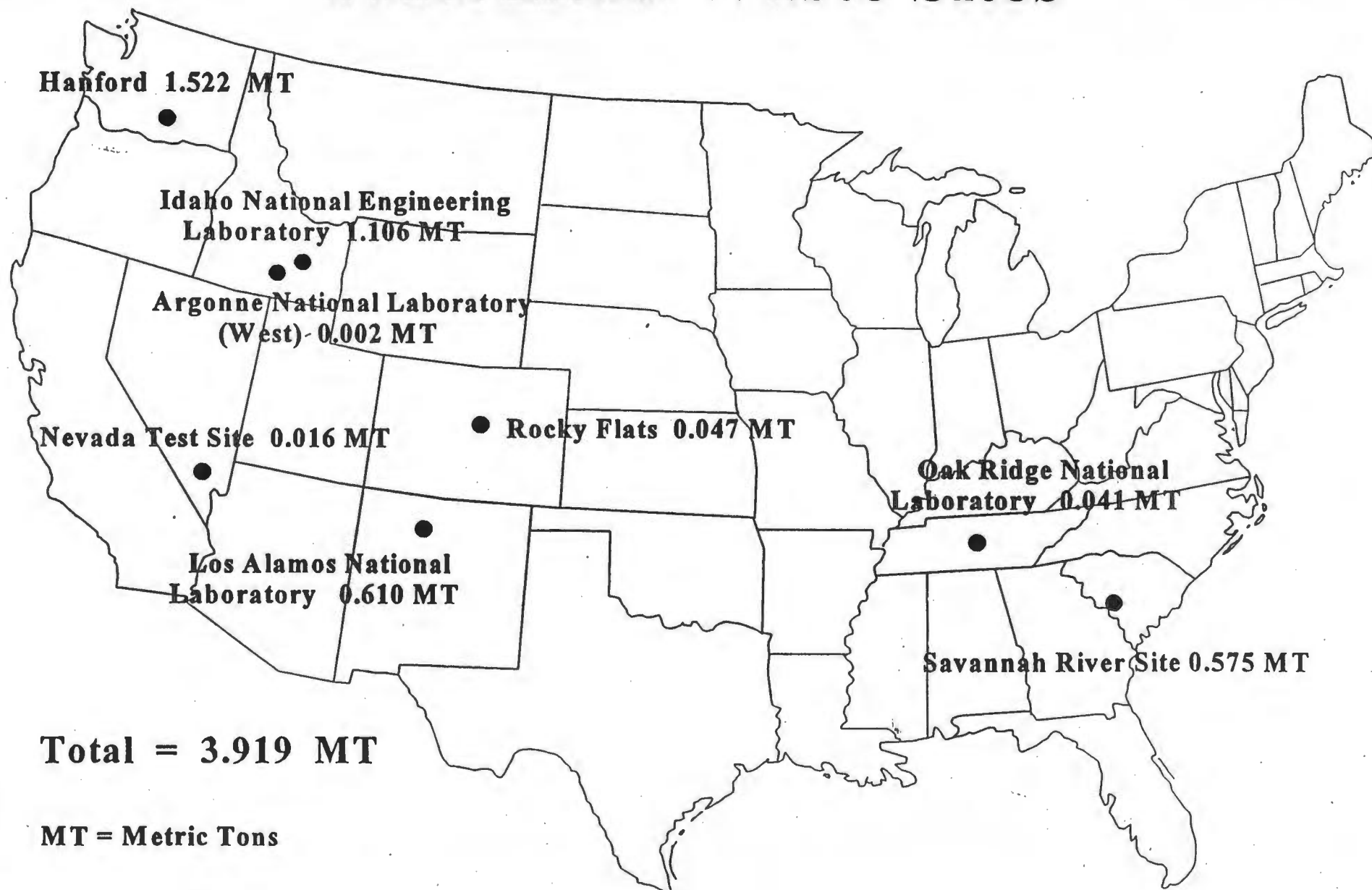
- The Public. Data will be available for public discussion of United States plutonium acquisition, production, and use.
- Public Interest Organizations. Stakeholders include environmental, safety, and health groups; historians, archivists, and researchers; scientists; industrial workers; and local, State, and Federal personnel. All groups interested in oversight of plutonium-related activities will now have additional information about plutonium production, acquisition, and use.
- Freedom of Information Act Users. Citizens submitting Freedom of Information Act requests will have greater access to the data they seek.

(More)

# Plutonium Inventories



# Plutonium Waste Sites



**Total = 3.919 MT**

**MT = Metric Tons**

# DOE

# FACTS

## DEPARTMENT OF ENERGY DECLASSIFIES LOCATION AND FORMS OF WEAPON-GRADE PLUTONIUM AND HIGHLY ENRICHED URANIUM INVENTORY EXCESS TO NATIONAL SECURITY NEEDS

The Department of Energy has declassified information about the location and form of the 212.5 metric tons of weapon-grade plutonium and highly enriched uranium that President Clinton recently identified as excess to national security needs.

### SPECIFICALLY:

- The special nuclear material that has been declared excess to national security needs is made up of weapon-grade plutonium and uranium-enriched to over 20 percent of U<sup>235</sup>.
- The excess inventory amounts to approximately 38.2 metric tons of weapon-grade plutonium and 174.3 metric tons of highly enriched uranium.
- The excess material amounts to approximately 20 percent of total United States production of plutonium and highly enriched uranium. The excess plutonium amounts to approximately one-half of today's inventory of weapon-grade plutonium.

(More)

U.S. Department of Energy  
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(202) 586-5806

U.S. Department of Energy  
Office of Nonproliferation and  
National Security  
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- The Department of Energy is also announcing the locations and quantities of the excess materials. Excess materials are part of current United States inventories at each site, which are determined not to be needed for future national security.

<u>Site:</u>	Weapon-grade Plutonium (Metric tons)	Highly Enriched Uranium (Metric tons)
Pantex Site plus planned dismantlements	21.3	16.7
Rocky Flats Environmental Technology Site	11.9	2.8
Hanford Site	1.7	0.5
Los Alamos National Laboratory	1.5	0.5
Savannah River Site	1.3	22.0
Idaho National Engineering Laboratory Site	0.4	23.4
Oak Ridge Site (including 10 metric tons previously placed under International Atomic Energy Agency safeguards)	--	84.9
Portsmouth Gaseous Diffusion Plant	--	22.5
Brookhaven National Laboratory	--	0.3
Sandia National Laboratories	--	0.2
Other sites (includes Government and non-Government sites, Department of Energy contractors, research institutes, and universities)	0.1	0.5
<b>TOTALS (may be affected by rounding)</b>	<b>38.2</b>	<b>174.3</b>

- Additional information on the forms and locations of the excess material is provided in the tables and maps attached to this announcement.
- To demonstrate further the commitment of the United States to the objectives of the Nuclear NonProliferation Treaty, of the 212.5 metric tons already declared excess, approximately 10 metric tons of the highly enriched uranium already has been placed under international safeguards at the Oak Ridge Y-12 Site.
- Weapons dismantlement and other programs continue to be reviewed and additional materials may be declared excess as national security requirements change. There will also be changes over time as a result of programmatic decisions such as disposition and consolidation.

(More)

BACKGROUND:

- President Clinton stated on March 1, 1995, in a speech at the Nixon Center for Peace and Freedom, "To further demonstrate our commitment to the goals of the (Nuclear NonProliferation) treaty, today I have ordered that 200 metric tons of fissile material -- enough for thousands of nuclear weapons -- be permanently withdrawn from the United States nuclear stockpile. It will never again be used to build a nuclear weapon."
- The National Security Council has performed a detailed review in conjunction with the Department of Energy and the Department of Defense of the weapon-grade plutonium and highly enriched uranium requirements to support the nuclear weapons program and other national security needs. Nuclear materials that are not required have been declared excess.
- National security needs relate to special nuclear material in active and inactive weapons, strategic reserve requirements, research and development, Naval Reactors, mutual defense requirements, and tritium production options.
- The Secretary of Energy announced, in her September 18, 1995, speech at the thirty-ninth session of the General Conference of the International Atomic Energy Agency in Vienna, Austria, that the approximate breakdown of the excess material is 38 metric tons of weapon-grade plutonium, 33 metric tons of uranium enriched to over 92 percent in  $U^{235}$ , and 142 metric tons of uranium enriched to between 20 and 92 percent in  $U^{235}$ . Today's announcement provides additional information on the forms and locations of the material.
- The quantities listed are based on the evaluation of available records. The quantities may be updated after re-evaluation of the original records.

BENEFITS:

- The American people will have additional information about the management and disposition of plutonium and highly enriched uranium. The United States hopes that the release of the information will encourage other nations to release similar information.
- Declaring the material excess to national security requirements and putting some of it under international safeguards demonstrates the United States' commitment to the objectives of the Nuclear NonProliferation Treaty and support for the International Atomic Energy Agency program to constrain nuclear proliferation. We hope that other nations will follow the United States example.

(More)

- The Department of Energy is completing technical, schedule, and cost analyses as well as environmental analyses, as required by the National Environmental Policy Act, to evaluate methods for disposing of excess highly enriched uranium and plutonium. In the case of highly enriched uranium, the Department of Energy has issued a draft and will soon complete an Environmental Impact Statement on the disposition of surplus highly enriched uranium. The Department proposes to eliminate the proliferation threat of highly enriched uranium by blending it down to low enriched uranium, which is not weapons-usable. Over time and where practical, this material will be sold as feed for commercial reactor fuel to recover its commercial value. Efforts in these regards will directly advance United States nonproliferation objectives, reduce stockpiles and associated safeguards and storage requirements, and provide financial returns to the United States Treasury.

Approximately 60 percent of the Department of Energy's surplus highly enriched uranium inventory (103 of the 174 metric tons) is in forms which may allow it to be used for down blending to low enriched uranium. However, the actual rate at which the resulting low enriched uranium could be made available for commercial use would be determined by many factors, including available industrial infrastructure, legislative and policy guidance, and future market conditions.

In the case of plutonium, the Department is completing a Programmatic Environmental Impact Statement on the long-term storage and disposition of surplus, weapons-usable plutonium. Environmental information from the Programmatic Environmental Impact Statement, as well as technical, schedule and cost analyses currently being prepared, will factor into a record of decision on surplus plutonium disposition at the end of 1996. The Department's efforts provide the basis for building public and political consensus and will provide the President the basis and flexibility to initiate implementation of plutonium disposition efforts.

- Release of information on the forms and locations of excess special nuclear materials will facilitate compliance with the requirements of the National Environmental Policy Act. It will allow the National Environmental Policy Act documents, such as Environmental Impact Statements, to better describe the materials requiring disposition, its location and disposition options.
- Release of this information further fosters the position of the United States as a global leader in nuclear transparency. We hope that these actions will encourage other nations to take similar steps.

(More)

- Release of this information demonstrates the commitment of the Department of Energy to openness. Once this material had been determined excess to national security needs, information concerning its forms and locations no longer required protection and has been released.
- Release of information, when no longer sensitive, increases trust in Government by demonstrating that only information of verified and current sensitivity will be classified and withheld from the public.

WHO ARE THE KEY STAKEHOLDERS?:

- Regulators. The International Atomic Energy Agency will safeguard some of the excess special nuclear material. The United States Nuclear Regulatory Commission will license facilities used for the disposition of excess special nuclear material.
- The Public. The public will have an opportunity for open discussions about the use and disposition of the excess highly enriched uranium and plutonium.
- Public Interest Organizations. Nonproliferation, environmental, and health and safety groups will be interested in the safeguarding, storage, transportation, and use of the materials.
- Freedom of Information Users. Citizens submitting Freedom of Information act requests will have greater access to the data they seek.

## HIGHLY ENRICHED URANIUM EXCESS TO NATIONAL SECURITY NEEDS LOCATIONS AND FORMS

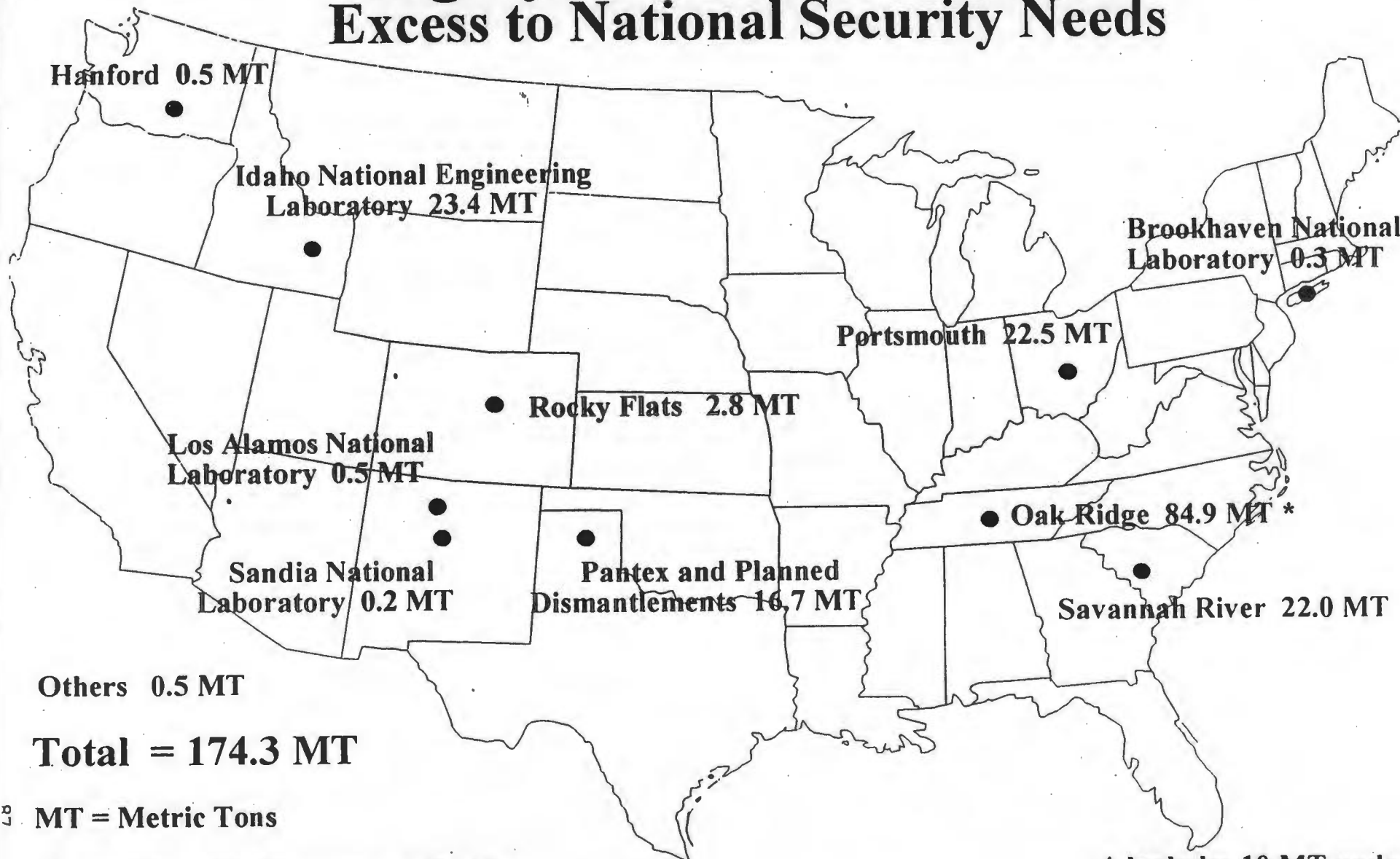
(DATA IN METRIC TONS)

LOCATION	METAL	OXIDES	UNIRRADIATED FUEL	IRRADIATED FUEL	OTHER FORMS	TOTAL
Oak Ridge Site	63.1	2.7	10.6	0.6	7.9	84.9
Idaho National Engineering Lab. Site	1.6	1.7	2.8	16.6	0.6	23.4
Portsmouth Plant	--	7.3	--	--	15.2	22.5
Savannah River Site						22.0
Pantex plus Planned Dismantlements	16.7	--	--	--	--	16.7
Rocky Flats Site	1.9	<0.1	0.6	--	0.4	2.8
Hanford Site	<0.1	0.1	0.1	0.3	0.1	0.5
Los Alamos National Laboratory	<0.1	0.3	0.1	<0.1	0.1	0.5
Brookhaven National Laboratory*	--	--	--	0.2	<0.1	0.3
Sandia National Laboratories	<0.1	0.1	<0.1	0.1	<0.1	0.2
Other Sites	<0.1	0.2	0.2	<0.1	<0.1	0.5
<b>TOTAL</b>						<b>174.3</b>

Note: Totals may not add up due to rounding.

\* Not a Weapons Program Facility

# Highly Enriched Uranium Excess to National Security Needs



Others 0.5 MT

**Total = 174.3 MT**

3 MT = Metric Tons

Highly enriched uranium is defined as  
having an enrichment above 20 % U-235

\* Includes 10 MT under  
inspection at Y-12

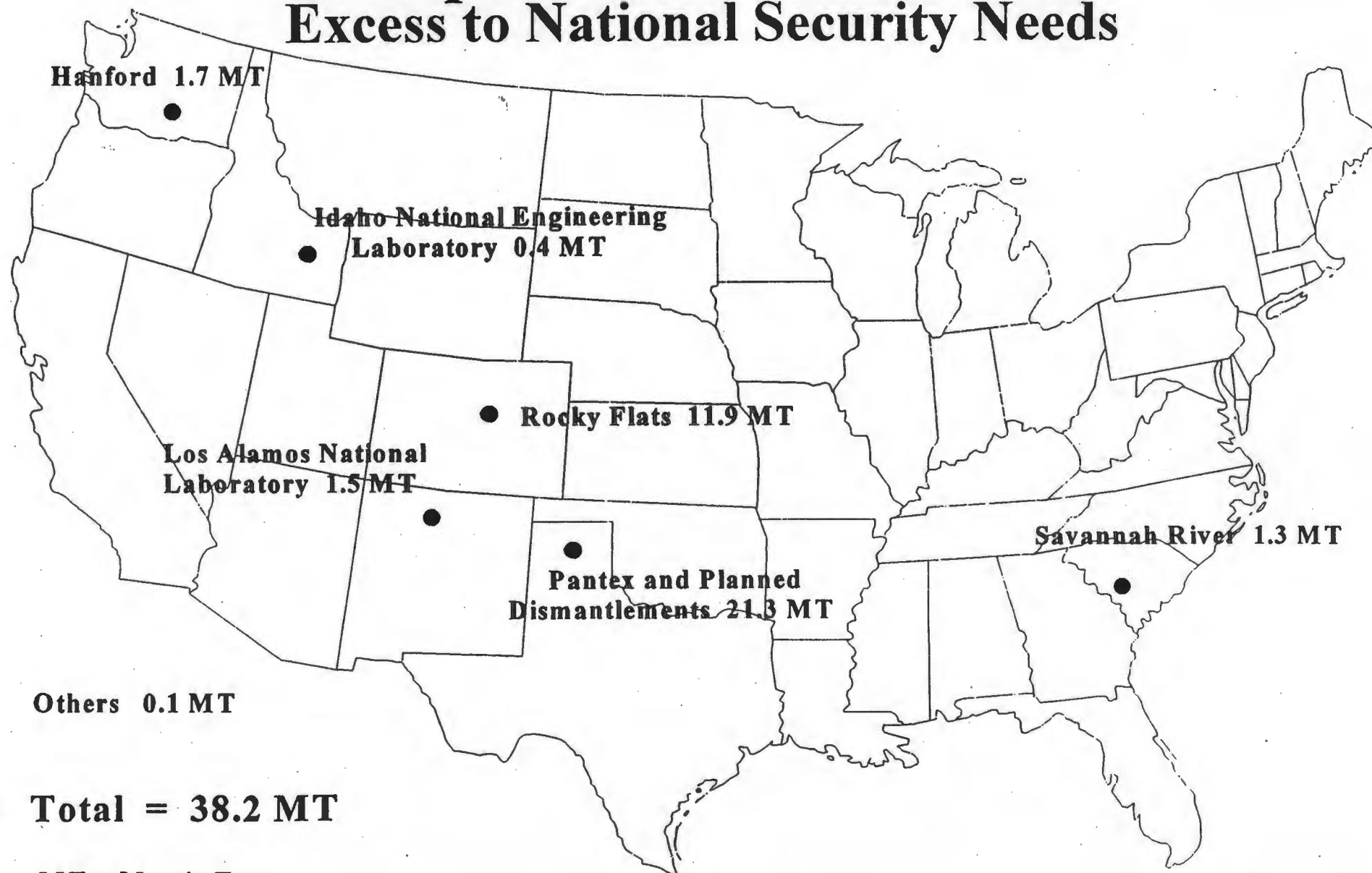
# **WEAPON-GRADE PLUTONIUM EXCESS TO NATIONAL SECURITY NEEDS LOCATIONS AND FORMS**

(DATA IN METRIC TONS)

LOCATION	METAL	OXIDES	UNIRRADIATED FUEL	IRRADIATED FUEL	OTHER FORMS	TOTAL
Pantex plus Planned Dismantlements	21.3	--	--	--	--	21.3
Rocky Flats Site	5.7	1.6	--	--	4.6	11.9
Hanford Site	<0.1	1.0	--	0.2	0.5	1.7
Los Alamos National Laboratory	0.5	<0.1	<0.1	--	1.0	1.6
Savannah River Site	0.4	0.5	--	0.2	0.2	1.3
Idaho National Engineering Lab. Site	<0.1	--	0.2	0.2	<0.1	0.4
Other Sites	<0.1	--	--	<0.1	<0.1	0.1
<b>TOTALS</b>	<b>27.8</b>	<b>3.1</b>	<b>0.2</b>	<b>0.6</b>	<b>6.4</b>	<b>38.2</b>

Note: Totals may not add up due to rounding.

# Weapon-Grade Plutonium Excess to National Security Needs



Others 0.1 MT

**Total = 38.2 MT**

MT = Metric Tons

EPA 1974a

EPA-350/9-74-004

U.S. DEPARTMENT OF COMMERCE  
National Technical Information Service

PB-239 429

INFORMATION ON LEVELS OF ENVIRONMENTAL NOISE  
REQUISITE TO PROTECT PUBLIC HEALTH AND WELFARE  
WITH AN ADEQUATE MARGIN OF SAFETY

ENVIRONMENTAL PROTECTION AGENCY

MARCH 1974

number of people living in areas which are exposed to freeway and aircraft noise are taken from the EPA airport/aircraft noise report.<sup>B-4</sup> They were based on calculated noise contours and associated populations for a few selected situations which formed the basis for extrapolation to national values. The estimates for the number of people living in areas in which the noise environment is dominated by urban traffic were developed from a survey<sup>B-5</sup> conducted in Summer 1973 for EPA. The survey measured the outdoor 24-hour noise environment at 100 sites located in 14 cities, including at least one city in each of the ten EPA regions. These data, supplemented with that from previous measurements at 30 additional sites, were correlated with census tract population density to obtain a general relationship between  $L_{dn}$  and population density. This relationship was then utilized, together with census data giving population in urban areas as a function of population density, to derive the national estimate given in Table B-2.

These data on urban noise enable an estimate of the percentage urban population in terms of both noise levels and the qualitative descriptions of urban residential areas which were utilized in the Title IV EPA report to Congress in 1971.<sup>B-6</sup>

These estimates, summarized in Table B-3, show that the majority of the 134 million people residing in urban areas have outdoor  $L_{dn}$  values ranging from 43 dB to 72 dB with a median value of 59 dB. The majority of the remainder of the population residing in rural or other non-urban areas is estimated to have outdoor  $L_{dn}$  values ranging between 35 and 50 dB.

### Indoor Sound Levels

The majority of the existing data regarding levels of environmental noise in residential areas has been obtained outdoors. Such data are useful in characterizing the neighborhood noise environment evaluating the noise of identifiable sources and relating the measured values with those calculated for planning purposes. For these purposes, the outdoor noise levels have proved more useful than indoor noise levels because the indoor noise levels contain the additional variability of individual building sound level reduction. This variability among dwelling units results from type of construction, interior furnishings, orientation of rooms relative to the noise, and the manner in which the dwelling unit is ventilated.

Data on the reduction of aircraft noise afforded by a range of residential structures are available.<sup>B-7</sup> These data indicate that houses can be approximately categorized into "warm climate" and "cold climate" types. Additionally, data are available for typical open-window and closed-window conditions. These data indicate that the sound level reduction provided by buildings within a given community has a wide range due to differences in the use of materials, building techniques, and individual building plans. Nevertheless, for

Table B-3  
ESTIMATED PERCENTAGE OF URBAN POPULATION (134 MILLION)  
RESIDING IN AREAS WITH VARIOUS DAY-NIGHT NOISE LEVELS TOGETHER  
WITH CUSTOMARY QUALITATIVE DESCRIPTION OF THE AREA<sup>B-3, B-4</sup>

	①	②	③	④
Description	Typical Range L <sub>dn</sub> in dB	Average L <sub>dn</sub> in dB	Estimated Percentage of Urban Population	Average Census Tract Population Density, Number of People Per Square Mile
Quiet Suburban Residential	48-52	50	12	630
Normal Suburban Residential	53-57	55	21	2,000
Urban Residential	58-62	60	28	6,300
Noisy Urban Residential	63-67	65	19	20,000
Very Noisy Urban Residential	68-72	70	7	63,000

planning purposes, the typical reduction in sound level from outside to inside a house can be summarized as follows in Table B-4. The approximate national average "window open" condition corresponds to an opening of 2 square feet and a room absorption of 300 sabins (typical average of bedrooms and living rooms). This window open condition has been assumed throughout this report in estimating conservative values of the sound levels inside dwelling units which results from outdoor noise.

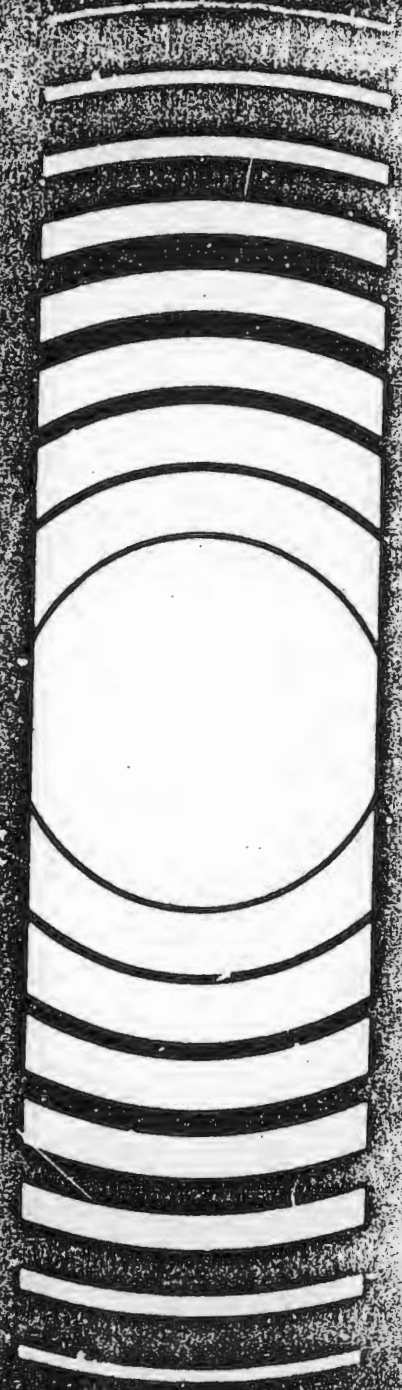
The sound levels inside dwelling units result from the noise from the outside environment plus the noise generated internally. The internally generated noise results from people activity, appliances and heating and ventilating equipment. Twenty-four hour continuous measurements were made in 12 living rooms (living, family or dining room) in 12 houses during the 100-site EPA survey<sup>B-5</sup> of urban noise, excluding areas where the noise resulted from freeways and aircraft. The results, summarized below in Table B-5, show that the inside day-night sound level in these homes was the result of internally generated noise. In fact, the internal L<sub>dn</sub> and L<sub>d</sub> values were slightly higher than those measured outdoors, despite the fact that the average house sound level reduction appeared to exceed 18 dB. The pattern for the indoor sound levels varies significantly among the homes, as portrayed by the data in Figure B-2. The hourly equivalent sound levels have an average minimum of approximately

EPA 1979a

EPA

PB80-122336

**Radiological Impact  
Caused by Emissions  
of Radionuclides  
into Air in the United States  
Preliminary Report**



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PB80-122336**

**Radiological Impact Caused by Emissions  
of Radionuclides into Air in the United  
States: Preliminary Report**

**(U.S.) Office of Radiation Programs, Washington, DC**

**Aug 79**

EPA 1981a

United States  
Environmental Protection  
Agency

Office of Air Quality  
Planning and Standards  
Research Triangle Park NC 27711

EPA-450/4-81-002  
January 1981

Air

P881-176539



# An Evaluation Study for the Industrial Source Complex (ISC) Dispersion Model

FORNIT BY:  
NATIONAL TECHNICAL  
INFORMATION SERVICE  
U.S. DEPARTMENT OF COMMERCE  
SPRINGFIELD, MA 01104

# **An Evaluation Study for the Industrial Source Complex (ISC) Dispersion Model**

by

**J.F. Bowers and A.J. Anderson**

**H.E. Cramer Company, Inc.  
University of Utah Research Park  
Post Office Box 8049  
Salt Lake City, Utah 84108**

**Contract No. 68-02-3323**

**EPA Project Officer: Sharon R. Kraft**

**Work Assignment No. 5**

**Prepared for**

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
Office of Air Quality Planning and Standards  
Source Receptor Analysis Branch  
Research Triangle Park, North Carolina 27711**

**January 1981**

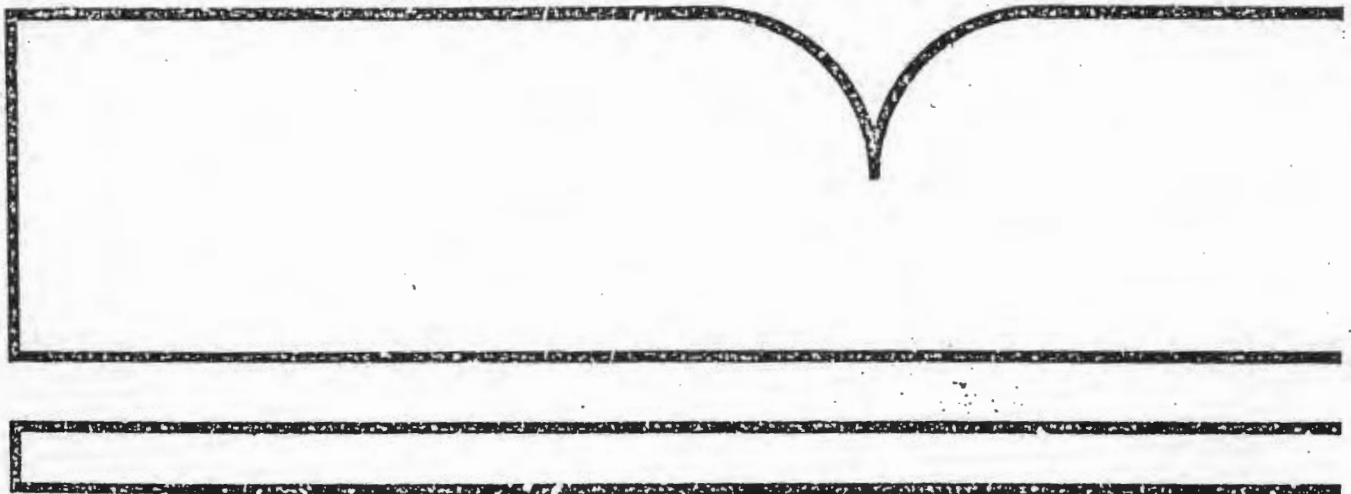
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(Please read instructions on the reverse before completing)

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7. AUTHOR(S) <b>J. F. Bowers and A. J. Anderson</b>				8. PERFORMING ORGANIZATION REPORT NO.	
9. PERFORMING ORGANIZATION NAME AND ADDRESS <b>H. E. Cramer Company, Inc. University of Utah Research Park P. O. Box 8049 Salt Lake City, Utah 84108</b>				10. PROGRAM ELEMENT NO.	
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16. ABSTRACT The Industrial Source Complex (ISC) Model contains several new features not contained in other guideline atmospheric dispersion models. The important features are the gravitational settling/dry deposition option and the building wake effects option. Performance of the ISC Model is compared with that of CRSTER for a single source and MPTER for multiple sources. Results indicate that these model options significantly improve model performance. Additional suggestions for model improvement are discussed.					
17. KEY WORDS AND DOCUMENT ANALYSIS					
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Air Pollution Atmospheric Models Meteorology Turbulent Diffusion		Industrial Sources Deposition Downwash Dispersion			
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Population Exposure to External Natural  
Radiation Background in the United States

(U.S.) Office of Radiation Programs  
Washington, DC

Apr 81



U.S. Department of Commerce  
National Technical Information Service

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POPULATION EXPOSURE TO EXTERNAL  
NATURAL RADIATION BACKGROUND  
IN THE UNITED STATES

Kenneth T. Bogen  
and  
Abraham S. Goldin

April 1981

Surveillance and Emergency Preparedness Division  
Office of Radiation Programs  
U. S. Environmental Protection Agency  
Washington, D.C. 20460

# ABSTRACT

This report revises estimates of population exposure to external natural background made by D. T. Oakley in 1972. The revisions include more recent estimates of dose equivalents from cosmic rays, use of 1970 U.S. census data, and corrections for building shielding and for self-shielding in the body. The dose equivalents calculated are those from cosmic rays and terrestrial radiation, and do not include doses from natural radioactive materials in the body.

The revised data, not including shielding corrections, give a mean dose equivalent of 71 millirems per year to the U.S. population. Twenty percent of the population receive less than 50 millirems per year, seventy percent less than 82 millirems per year, and ninety-five percent less than 108 millirems per year. These dose equivalents, which correspond approximately to skin dose equivalents out-of-doors, are useful for comparison with other exposures measured or stated without shielding corrections.

The revised data, including shielding corrections, give a mean dose equivalent of 53 millirems per year to the United States population. Twenty percent receive dose equivalents less than 38 millirems per year, seventy percent less than 58 millirems per year, and ninety-five percent less than 76 millirems per year. These dose equivalents correspond approximately to those received by internal organs, such as gonads or red marrow. They are useful for estimating dose equivalents received by these organs and for estimating population health risks from natural radiation.

EPA 1982a

PB82-257312

United States  
Environmental Protection  
Agency

Office of Air Quality  
Planning and Standards  
Research Triangle Park NC 27711

EPA-450/4-82-006  
February 1982

Air



# TESTS OF THE INDUSTRIAL SOURCE COMPLEX (ISC) DISPERSION MODEL AT THE ARMCO MIDDLETOWN, OHIO STEEL MILL

REPRODUCED BY  
NATIONAL TECHNICAL  
INFORMATION SERVICE  
85 DEPARTMENT OF COMMERCE  
SPRINGFIELD, MA 01104

**EPA-450/4-82-006**

# **Tests of the Industrial Source Complex (ISC) Dispersion Model at the Armco, Middletown, Ohio Steel Mill**

**Prepared by**

**J.F. Bowers, A.J. Anderson and W.R. Hargraves**

**Prepared for**

**Source Receptor Analysis Branch  
U.S. Environmental Protection Agency  
Research Triangle Park, North Carolina 27711**

**EPA Contract No. 68-02-3323  
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**H.E. Cramer Company, Inc.  
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## 15. SUPPLEMENTARY NOTES

## 16. ABSTRACT

The primary purpose of the study described in this report was to test the performance of the gravitational settling/dry deposition of the Industrial Source Complex (ISC) Dispersion Model using the 1980 particulate air quality measurements made by Armco and EPA in the vicinity of the Armco Steel Mill at Middletown, Ohio, with the corresponding Armco emissions data. Statistical comparisons of calculated and observed concentrations, made following the procedures suggested by an AMS Workshop on Dispersion Model Performance, show that use of the ISC Model's gravitational settling/dry deposition option yields calculated total suspended particulate concentrations in closer agreement with the observed air quality than the corresponding concentrations calculated by the model without using this option. Because the particulate concentrations calculated by the ISC Model without using this option are representative of the concentrations that would be calculated using the modeling techniques recommended for application to particulate sources in the current (April 1978) EPA Guideline on Air Quality Models, the results of the study indicate that the ISC Model with the gravitational settling/dry deposition option is an improvement over the modeling techniques currently recommended for particulate sources.

## KEY WORDS AND DOCUMENT ANALYSIS

DESCRIPTORS	IDENTIFIERS OPEN ENDED TERMS	COSATI Field Group
Air Pollution Atmospheric Models Meteorology Turbulent Diffusion Particulate Matter	Industrial Sources Deposition Downwash Dispersion Model Evaluation	13B
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In addition to the authors, other staff members of the H. E. Cramer Company, Inc. made important contributions to the preparation of this report. We are especially indebted to Mr. Jay Bjorklund, Mr. Craig Cheney and Ms. Margret Boes for their assistance in performing the computer calculations. The technical illustrations were prepared by Mr. Kay Memmott and the report was typed by Ms. Sarah Barlow, Ms. Cherin Christensen and Ms. Bonnie Swanson.



EPRI 1983a

EPRI-EA--3074

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# Overview, Results, and Conclusions for the EPRI Plume Model Validation and Development Project: Plains Site

100

**Overview, Results, and Conclusions for the  
EPRI Plume-Model Validation and  
Development Project: Plains Site**

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**EA-3074  
Research Project 1616-1**

**Final Report, May 1983**

**Prepared by**

**TRC-ENVIRONMENTAL CONSULTANTS, INC.  
800 Connecticut Boulevard  
East Hartford, Connecticut 06108**

**Principal Investigators**

**N. E. Bowne  
R. J. Londergan**

**Contributors**

**D. R. Murray  
H. S. Borenstein**

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**Prepared for**

**Electric Power Research Institute  
3412 Hillview Avenue  
Palo Alto, California 94304**

**EPRI Project Manager  
G. R. Hirst**

**Environmental Physics and Chemistry Program  
Energy Analysis and Environment Division**

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## ABSTRACT

The Electric Power Research Institute's (EPRI) Plume Model Validation and Development (PMV&D) Project is designed to provide data bases and analyses for rigorous operational and diagnostic validation of plume models. The behavior and fate of buoyant plumes emitted from tall stacks are the foci of attention. The project is field measurement oriented and is configured to generate data about plume behavior in three levels of topographic complexity. A staff of nine contractors and subcontractors designed methods, performed measurements, and conducted analyses to determine the behavior of plumes emitted from an isolated electric generating station located on a simple plain in Illinois. The measurement effort comprising the basis for this report is the first of three such field programs. It employed 200 tracer samplers, 30 air quality samplers, 2 aircraft, and 3 remote-sensing devices to document the plume's behavior and ground-level impact. The measurements were made during the spring and summer of 1980 and the spring of 1981.

The present report is intended as an overview of the project and a summary of the results and conclusions from the first set of field measurements. Three Gaussian models, commonly used for operational and regulatory purposes, and two numerical simulation models with first-order closure were tested against measured ground-level plume concentrations. Objective validation protocols and statistical methodologies developed for plume model validation were employed in these tests of model performance.

The model performance results clearly demonstrated important shortcomings in all the models tested, including a general inability to estimate hour-by-hour ground-level concentrations plus specific deficiencies of individual model components. Critical needs for improving model performance include better atmospheric stability indicators and a better model framework to estimate both peak concentration values and frequency distributions of concentrations. The PMV&D Project Plains Site data base provides a unique, comprehensive set of measurements of buoyant plume dispersion. Significant improvements in existing plume models and new model developments can be achieved through further study employing these data.

Exxon-1981a

AUG 13 1981

FCUP:EYS  
Docket No. 70-1257

Docket File 70-1257

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Exxon Nuclear Company, Inc.  
ATTN: Mr. Charles Malody, Manager  
Licensing & Compliance  
2101 Horn Rapids Road  
Richland, Washington 99352

Gentlemen:

The Nuclear Regulatory Commission, Division of Fuel Cycle and Material Safety, has issued a Negative Declaration and an Environmental Impact Appraisal related to the renewal of Special Nuclear Material License No. SNM-1227 for the continued operation of Exxon Nuclear Company, Inc. at Richland, Washington. A copy of the Negative Declaration, which has been sent to the Office of the Federal Register for publication, and the supporting Environmental Impact Appraisal are enclosed.

Sincerely,

Original signed by

W. T. Crow

R. G. Page, Chief  
Uranium Fuel Licensing Branch  
Division of Fuel Cycle and  
Material Safety

Enclosures:

1. Federal Register Notice
2. Environmental Impact Appraisal

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**FWS-1979a**

FWS/OBS-79/31  
DECEMBER 1979

# **Classification of Wetlands and Deepwater Habitats of the United States**



Fish and Wildlife Service

U.S. Department of the Interior

**FILE COPY**

FWS 1995a

Message: 4

montroy@ix.netcom.com (Leo Montroy)

From: R9IRMLIB@mail.fws.gov

Subject: Re: send state lists

Date: Tue, 25 Apr 95 13:37:26 MST

The attached file provides U.S. State and Territory lists of endangered and threatened species under U.S. Fish and Wildlife Service jurisdiction listed at 50 CFR Parts 17.11 and 17.12. The State lists give likely current ranges based on the best scientific survey information available to the Service and do not include species believed to be long extirpated from a given State or Territory.

U.S. FISH AND WILDLIFE SERVICE  
DIVISION OF ENDANGERED SPECIES

LISTED SPECIES UNDER FISH AND WILDLIFE SERVICE JURISDICTION  
BY STATE/TERRITORY AS OF 03/31/95

Alabama--87 species

Animals--69 species

Acornshell, southern (*Epioblasma othcaloogensis*)  
Bat, Indiana (*Myotis sodalis*)  
Bat, gray (*Myotis grisescens*)  
Bowfin, Alabama (*Speoplatyrhinus poulsoni*)  
Chub, spotfin (=turquoise shiner) (*Cyprinella* (=Hybopsis) *monacha*)  
Clubshell, black (=Curtus' mussel) (*Pleurobema curtum*)  
Clubshell, ovate (*Pleurobema perovatum*)  
Clubshell, southern (*Pleurobema decisum*)  
Combshell, southern (=penitent mussel) (*Epioblasma penita*)  
Combshell, upland (*Epioblasma metastriata*)  
Darter, boulder (=Elk River) (*Etheostoma wapiti*)  
Darter, goldline (*Percina aurolineata*)  
Darter, slackwater (*Etheostoma boschungii*)  
Darter, snail (*Percina tanasi*)  
Darter, watercress (*Etheostoma nuchale*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Fanshell (*Cyprogenia stegaria*)  
Heelsplitter, inflated (*Potamilus inflatus*)  
Kidneyshell, triangular (*Ptychobranhus greeni*)  
Lampmussel, Alabama (*Lampsilis virescens*)  
Manatee, West Indian (=Florida) (*Trichechus manatus*)  
Moccasinshell, Alabama (*Medionidus acutissimus*)  
Moccasinshell, Coosa (*Medionidus parvulus*)  
Mouse, Alabama beach (*Peromyscus polionotus ammobates*)  
Mouse, Perdido Key beach (*Peromyscus polionotus trissyllepsis*)  
Mucket, orange-nacre (*Lampsilis perovalis*)  
Mussel, ring pink (=golf stick pearly) (*Obovaria retusa*)  
Pearlymussel, Cumberland monkeyface (*Quadrula intermedia*)  
Pearlymussel, cracking (*Hemistena lata*)  
Pearlymussel, dromedary (*Dromus dromas*)  
Pearlymussel, little-wing (*Pegias fabula*)  
Pearlymussel, orange-foot pimple back (*Plethobasus cooperianus*)  
Pearlymussel, pale lilliput (*Toxolasma cylindrellus*)  
Pearlymussel, pink mucket (*Lampsilis abrupta*)  
Pearlymussel, purple cat's paw (*Epioblasma obliquata obliquata*)  
Pearlymussel, turgid-blossom (*Epioblasma turgidula*)

Pearlymussel, white wartyback (*Plethobasus cicatricosus*)  
 Pearlymussel, yellow-blossom (*Epioblasma florentina florentina*)  
 Pigtoe, dark (*Pleurobema furvum*)  
 Pigtoe, fine-rayed (*Fusconaia cuneolus*)  
 Pigtoe, flat (=Marshall's mussel) (*Pleurobema marshalli*)  
 Pigtoe, heavy (=Judge Tait's mussel) (*Pleurobema taitianum*)  
 Pigtoe, rough (*Pleurobema plenum*)  
 Pigtoe, shiny (*Fusconaia cor* (=edgariana))  
 Pigtoe, southern (*Pleurobema georgianum*)  
 Plover, piping (*Charadrius melodus*)  
 Pocketbook, fine-lined (*Lampsilis altilis*)  
 Riversnail, Anthony's (*Athearnia anthonyi*)  
 Salamander, Red Hills (*Phaeognathus hubrichti*)  
 Sculpin, pygmy (*Cottus pygmaeus*)  
 Shiner, Cahaba (*Notropis cahabae*)  
 Shiner, Palezone (*Notropis* sp.)  
 Shiner, blue (*Cyprinella* (=Notropis) caerulea)  
 Shrimp, Alabama cave (*Palaemonias alabamiae*)  
 Snail, tulotoma (=Alabama live-bearing) (*Tulotoma magnifica*)  
 Snake, eastern indigo (*Drymarchon corais couperi*)  
 Stirrupshell (*Quadrula stapes*)  
 Stork, wood (*Mycteria americana*)  
 Sturgeon, Gulf (*Acipenser oxyrhynchus desotoi*)  
 Tortoise, gopher (*Gopherus polyphemus*)  
 Turtle, Alabama redbelly (=red-bellied) (*Pseudemys alabamensis*)  
 Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
 Turtle, flattened musk (*Sternotherus depressus*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, hawksbill sea (*Eretmochelys imbricata*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, loggerhead sea (*Caretta caretta*)  
 Woodpecker, red-cockaded (*Picoides borealis*)

#### Plants--18 species

Alabama canebreak pitcher-plant (*Sarracenia rubra* ssp. *alabamensis*)  
 Alabama leather-flower (*Clematis socialis*)  
 Alabama streak-sorus fern (*Thelypteris pilosa* var. *alabamensis*)  
 American hart's-tongue fern (*Asplenium scolopendrium* var. *americanum*)  
 Gentian pinkroot (*Spigelia gentianoides*)  
 Green pitcher-plant (*Sarracenia oreophila*)  
 Harperella (*Ptilimnium nodosum* (=fluviatile))  
 Kral's water-plantain (*Sagittaria secundifolia*)  
 Leafy prairie-clover (*Dalea* (=Petalostemum) *foliosa*)  
 Little amphianthus (*Amphianthus pusillus*)  
 Lyrate bladderpod (*Lesquerella lyrata*)  
 Mohr's Barbara's buttons (*Marshallia mohrii*)  
 Morefield's leather-flower (*Clematis morefieldii*)  
 Pondberry (*Lindera melissifolia*)  
 Price's potato-bean (*Apios priceana*)  
 Relict trillium (*Trillium reliquum*)  
 Rock cress (*Arabis perstellata*)  
 Tennessee yellow-eyed grass (*Xyris tennesseensis*)

#### Alaska--5 species

#### Animals--4 species

Curlew, Eskimo (*Numenius borealis*)  
 Eider, spectacled (*Somateria fischeri*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Goose, Aleutian Canada (*Branta canadensis leucopareia*)

#### Plants--1 species

Aleutian shield-fern (=Aleutian holly-fern) (*Polystichum aleuticum*)

## Arizona--46 species

### Animals--31 species

Ambersnail, Kanab (*Oxyloma haydeni kanabensis*)  
Bat, lesser (=Sanborn's) long-nosed (*Leptonycteris curasoae yerbabuena*  
e)  
Bobwhite, masked (quail) (*Colinus virginianus ridgwayi*)  
Catfish, Yaqui (*Ictalurus pricei*)  
Chub, Sonora (*Gila ditaenia*)  
Chub, Virgin River (*Gila robusta semidnuda*)  
Chub, Yaqui (*Gila purpurea*)  
Chub, bonytail (*Gila elegans*)  
Chub, humpback (*Gila cypha*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Flycatcher, Southwestern willow (*Empidonax traillii extimus*)  
Jaguarundi (*Felis yagouaroundi tolteca*)  
Minnow, loach (*Rhinichthys* (=Tiaroga) *cobitis*)  
Ocelot (*Felis pardalis*)  
Owl, Mexican spotted (*Strix occidentalis lucida*)  
Pronghorn, Sonoran (*Antilocapra americana sonoriensis*)  
Pupfish, desert (*Cyprinodon macularius*)  
Rail, Yuma clapper (*Rallus longirostris yumanensis*)  
Shiner, beautiful (*Cyprinella* (=Notropis) *formosa*)  
Spikedace (*Meda fulgida*)  
Spinedace, Little Colorado (*Lepidomeda vittata*)  
Squawfish, Colorado (*Ptychocheilus lucius*)  
Squirrel, Mount Graham red (*Tamiasciurus hudsonicus grahamensis*)  
Sucker, razorback (*Xyrauchen texanus*)  
Spoonminnow, Gila (incl. Yaqui) (*Poeciliopsis occidentalis*)  
Tortoise, desert (*Gopherus agassizii*)  
Trout, Apache (=Arizona) (*Oncorhynchus* (=Salmo) *apache*)  
Trout, Gila (*Oncorhynchus* (=Salmo) *gilae*)  
Vole, Hualapai Mexican (*Microtus mexicanus hualpaiensis*)  
Woundfin (*Plagopterus argentissimus*)

### Plants--15 species

Arizona agave (*Agave arizonica*)  
Arizona cliffrose (*Purshia subintegra*)  
Arizona hedgehog cactus (*Echinocereus triglochidiatus* var. *arizonicus*)  
Brady pincushion cactus (*Pediocactus bradyi*)  
Cochise pincushion cactus (*Coryphantha* (=Escobaria) *robbinsorum*)  
Jones cycladenia (*Cycladenia humilis* var. *jonesii*)  
Kearney's blue-star (*Amsonia kearneyana*)  
Navajo sedge (*Carex specuicola*)  
Nichol's Turk's head cactus (*Echinocactus horizonthalonius* var. *nicholii*)  
Peebles Navajo cactus (*Pediocactus peeblesianus* var. *peeblesianus*)  
Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*)  
San Francisco Peaks groundsel (*Senecio franciscanus*)  
Sentry milk-vetch (*Astragalus cremonophylax* var. *cremonophylax*)  
Siler pincushion cactus (*Pediocactus sileri*)  
Welsh's milkweed (*Asclepias welshii*)

## Arkansas--25 species

### Animals--20 species

Bat, Indiana (*Myotis sodalis*)  
Bat, Ozark big-eared (*Plecotus townsendii ingens*)  
Bat, gray (*Myotis grisescens*)  
Beetle, American burying (=giant carrion) (*Nicrophorus americanus*)

Cavefish, Ozark (*Amblyopsis rosae*)  
 Crayfish, cave [no common name] (*Cambarus aculabrum*)  
 Crayfish, cave [no common name] (*Cambarus zophonastes*)  
 Darter, leopard (*Percina pantherina*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Fatmucket, Arkansas (*Lampsilis powelli*)  
 Pearlmussel, Curtis' (*Epioblasma (=Dysnomia) florentina curtisi*)  
 Pearlmussel, pink mucket (*Lampsilis abrupta*)  
 Pocketbook, fat (*Potamilus (=Proptera) capax*)  
 Pocketbook, speckled (*Lampsilis streckeri*)  
 Rock-pocketbook, Ouachita (=Wheeler's pearly mussel) (*Arkansia wheeleri*)  
 Shagreen, Magazine Mountain (*Mesodon magazinensis*)  
 Sturgeon, pallid (*Scaphirhynchus albus*)  
 Tern, least (*Sterna antillarum*)  
 Woodpecker, red-cockaded (*Picoides borealis*)

#### Plants--5 species

Geocarpon minimum (Plant, no common name)  
 Eastern prairie fringed orchid (*Platanthera leucophaea*)  
 Harperella (*Ptilimnium nodosum (=fluviatile)*)  
 Pondberry (*Lindera melissifolia*)  
 Running buffalo clover (*Trifolium stoloniferum*)

#### California--156 species

#### Animals--80 species

Beetle, delta green ground (*Elaphrus viridis*)  
 Beetle, valley elderberry longhorn (*Desmocerus californicus dimorphus*)  
 Butterfly, El Segundo blue (*Euphilotes battoides allyni*)  
 Butterfly, Lange's metalmark (*Apodemia mormo langei*)  
 Butterfly, Myrtle's silverspot (*Speyeria zerene myrtleae*)  
 Butterfly, Oregon silverspot (*Speyeria zerene hippolyta*)  
 Butterfly, Palos Verdes blue (*Glaucopsyche lygdamus palosverdesensis*)  
 Butterfly, San Bruno elfin (*Callophrys mossii bayensis*)  
 Butterfly, Smith's blue (*Euphilotes enoptes smithi*)  
 Butterfly, bay checkerspot (*Euphydryas editha bayensis*)  
 Butterfly, lotis blue (*Lycaeides argyrognomon lotis*)  
 Butterfly, mission blue (*Icaricia icarioides missionensis*)  
 Chub, Mohave tui (*Gila bicolor mohavensis*)  
 Chub, Owens tui (*Gila bicolor snyderi*)  
 Chub, bonytail (*Gila elegans*)  
 Condor, California (*Gymnogyps californianus*)  
 Crayfish, Shasta (=placid) (*Pacifastacus fortis*)  
 Delta smelt (*Hypomesus transpacificus*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Fairy shrimp, Conservancy (*Branchinecta conservatio*)  
 Fairy shrimp, longhorn (*Branchinecta longiantenna*)  
 Fairy shrimp, riverside (*Streptocephalus woottoni*)  
 Fairy shrimp, vernal pool (*Branchinecta lynchi*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Fly, Delhi Sands flower-loving (*Rhaphiomidas terminatus abdominalis*)  
 Flycatcher, Southwestern willow (*Empidonax traillii extimus*)  
 Fox, San Joaquin kit (*Vulpes macrotis mutica*)  
 Gnatcatcher, coastal California (*Polioptila californica californica*)  
 Goby, tidewater (*Eucyclogobius newberryi*)  
 Goose, Aleutian Canada (*Branta canadensis leucopareia*)  
 Kangaroo rat, Fresno (*Dipodomys nitratoides exilis*)  
 Kangaroo rat, Morro Bay (*Dipodomys heermanni morroensis*)  
 Kangaroo rat, Stephens' (*Dipodomys stephensi* (incl. *D. cascus*))  
 Kangaroo rat, Tipton (*Dipodomys nitratoides nitratoides*)  
 Kangaroo rat, giant (*Dipodomys ingens*)  
 Lizard, Coachella Valley fringe-toed (*Uma inornata*)

Lizard, Island night (*Xantusia riversiana*)  
 Leopard, blunt-nosed leopard (*Gambelia silus*)  
 Lizard, Kern primrose sphinx (*Euproserpinus euterpe*)  
 Mountain beaver, Point Arena (*Aplodontia rufa nigra*)  
 Mouse, Pacific pocket (*Perognathus longimembris pacificus*)  
 Mouse, salt marsh harvest (*Reithrodontomys raviventris*)  
 Murrelet, marbled (*Brachyramphus marmoratus marmoratus*)  
 Otter, southern sea (*Enhydra lutris nereis*)  
 Owl, northern spotted (*Strix occidentalis caurina*)  
 Pelican, brown (*Pelecanus occidentalis*)  
 Plover, western snowy (*Charadrius alexandrinus nivosus*)  
 Pupfish, Owens (*Cyprinodon radiosus*)  
 Pupfish, desert (*Cyprinodon macularius*)  
 Rail, California clapper (*Rallus longirostris obsoletus*)  
 Rail, Yuma clapper (*Rallus longirostris yumanensis*)  
 Rail, light-footed clapper (*Rallus longirostris levipes*)  
 Salamander, Santa Cruz long-toed (*Ambystoma macrodactylum croceum*)  
 Salamander, desert slender (*Batrachoseps aridus*)  
 Shrike, San Clemente loggerhead (*Lanius ludovicianus mearnsi*)  
 Shrimp, California freshwater (*Syncaris pacifica*)  
 Snail, Morro shoulderband (=banded dune) (*Helminthoglypta walkeriana*)  
 Snake, San Francisco garter (*Thamnophis sirtalis tetrataenia*)  
 Snake, giant garter (*Thamnophis gigas*)  
 Sparrow, San Clemente sage (*Amphispiza belli clementeae*)  
 Squawfish, Colorado (*Ptychocheilus lucius*)  
 Stickleback, unarmored threespine (*Gasterosteus aculeatus williamsoni*)  
 Sucker, Lost River (*Deltistes luxatus*)  
 Sucker, Modoc (*Catostomus microps*)  
 Sucker, razorback (*Xyrauchen texanus*)  
 Sucker, shortnose (*Chasmistes brevirostris*)  
 Tadpole shrimp, vernal pool (*Lepidurus packardii*)  
 Tern, California least (*Sterna antillarum browni*)  
 Toad, arroyo southwestern (*Bufo microscaphus californicus*)  
 Tortoise, desert (*Gopherus agassizii*)  
 Towhee, Inyo California (=brown) (*Pipilo crissalis eremophilus*)  
 Trout, Lahontan cutthroat (*Oncorhynchus* (=Salmo) *clarki henshawi*)  
 Trout, Little Kern golden (*Oncorhynchus* (=Salmo) *aguabonita whitei*)  
 Trout, Paiute cutthroat (*Oncorhynchus* (=Salmo) *clarki seleniris*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, loggerhead sea (*Caretta caretta*)  
 Turtle, olive (=Pacific) ridley sea (*Lepidochelys olivacea*)  
 Vireo, least Bell's (*Vireo bellii pusillus*)  
 Vole, Amargosa (*Microtus californicus scirpensis*)

#### Plants--76 species

Amargosa niterwort (*Nitrophila mohavensis*)  
 Antioch Dunes evening-primrose (*Oenothera deltoides* ssp. *howellii*)  
 Ash Meadows gumplant (*Grindelia fraxino-pratensis*)  
 Bakersfield cactus (*Opuntia treleasei*)  
 Beach layia (*Layia carnosa*)  
 Ben Lomond spineflower (*Chorizanthe pungens* var. *hartwegiana*)  
 Ben Lomond wallflower (*Erysimum teretifolium*)  
 Burke's goldfields (*Lasthenia burkei*)  
 Butte County meadowfoam (*Limnanthes floccosa* ssp. *californica*)  
 California Orcutt grass (*Orcuttia californica*)  
 California jewelflower (*Caulanthus californicus*)  
 California seablite (*Suaeda californica*)  
 Chorro Creek bog thistle (*Cirsium fontinale obispoense*)  
 Clover lupine (*Lupinus tidestromii*)  
 Contra Costa wallflower (*Erysimum capitatum* var. *angustatum*)  
 Coyote ceanothus (=Coyote Valley California-lilac) (*Ceanothus ferrisae*)  
 Cushmanbury buckwheat (*Eriogonum ovalifolium* var. *vineum*)  
 Cushmanbury milk-vetch (*Astragalus albens*)  
 Cushmanbury oxytheca (*Oxytheca parishii* var. *goodmaniana*)

Eureka Dune grass (*Swallenia alexandrae*)  
 Eureka Valley evening-primrose (*Oenothera avita* ssp. *eurekensis*)  
 Mountain thistle (*Cirsium fontinale* var. *fontinale*)  
 Gambel's watercress (*Rorippa gambellii*)  
 Hoover's woolly-star (*Eriastrum hooveri*)  
 Howell's spineflower (*Chorizanthe howellii*)  
 Indian Knob mountain balm (*Eriodictyon altissimum*)  
 Kern mallow (*Eremalche kernensis*)  
 Large-flowered fiddleneck (*Amsinckia grandiflora*)  
 Loch Lomond coyote-thistle (*Eryngium constancei*)  
 Marin dwarf-flax (*Hesperolinon congestum*)  
 Marsh sandwort (*Arenaria paludicola*)  
 McDonald's rock-cress (*Arabis mcdonaldiana*)  
 Menzies' wallflower (*Erysimum menziesii*)  
 Metcalf Canyon jewelflower (*Streptanthus albidus* ssp. *albidus*)  
 Monterey gilia (*Gilia tenuiflora* ssp. *arenaria*)  
 Monterey spineflower (*Chorizanthe pungens* var. *pungens*)  
 Morro manzanita (*Arctostaphylos morroensis*)  
 Otay mesa mint (*Pogogyne nudiuscula*)  
 Palmate-bracted bird's-beak (*Cordylanthus palmatus*)  
 Parish's daisy (*Erigeron parishii*)  
 Pedate checker-mallow (*Sidalcea pedata*)  
 Pennell's bird's-beak (*Cordylanthus tenuis* ssp. *capillaris*)  
 Pismo clarkia (*Clarkia speciosa immaculata*)  
 Presidio (=Raven's) manzanita (*Arctostaphylos hookeri* var. *ravenii*)  
 Presidio clarkia (*Clarkia franciscana*)  
 Robust spineflower (includes Scotts Valley spineflower) (*Chorizanthe robusta*)  
 Salt marsh bird's-beak (*Cordylanthus maritimus* ssp. *maritimus*)  
 San Benito evening-primrose (*Camissonia benitensis*)  
 San Bernardino Mountains bladderpod (*Lesquerella kingii* ssp. *bernardiana*)  
 San Clemente Island Indian paintbrush (*Castilleja grisea*)  
 San Clemente Island broom (*Lotus dendroideus* ssp. *traskiae*)  
 San Clemente Island bush-mallow (*Malacothamnus clementinus*)  
 San Clemente Island larkspur (*Delphinium variegatum* ssp. *kinkiense*)  
 San Diego button-celery (*Eryngium aristulatum* var. *parishii*)  
 San Diego mesa mint (*Pogogyne abramsii*)  
 San Joaquin woolly-threads (*Lembertia congdonii*)  
 San Mateo thornmint (*Acanthomintha obovata* ssp. *duttonii*)  
 San Mateo woolly sunflower (*Eriophyllum latilobum*)  
 Santa Ana River woolly-star (*Eriastrum densifolium* ssp. *sanctorum*)  
 Santa Barbara Island liveforever (*Dudleya traskiae*)  
 Santa Clara Valley dudleya (*Dudleya setchellii*)  
 Santa Cruz cypress (*Cupressus abramsiana*)  
 Sebastopol meadowfoam (*Limnanthes vinculans*)  
 Slender-horned spineflower (*Dodecahema leptoceras*)  
 Slender-petaled mustard (*Thelypodium stenopetalum*)  
 Solano grass (*Tuctoria mucronata*)  
 Sonoma spineflower (*Chorizanthe valida*)  
 Sonoma sunshine (=Baker's stickyseed) (*Blennosperma bakeri*)  
 Spring-loving centaury (*Centaureum namophilum*)  
 Tiburon mariposa lily (*Calochortus tiburonensis*)  
 Tiburon jewelflower (*Streptanthus niger*)  
 Tiburon paintbrush (*Castilleja affinis* ssp. *neglecta*)  
 Truckee barberry (*Berberis sonnei*)  
 Water howellia (*Howellia aquatilis*)  
 Western lily (*Lilium occidentale*)  
 White-rayed pentachaeta (*Pentachaeta bellidiflora*)

Colorado--29 species

Animals--17 species

Bear, grizzly (*Ursus arctos*)  
 Butterfly, Uncompahgre fritillary (*Boloria acrocnema*)

Chub, bonytail (*Gila elegans*)  
 Chub, humpback (*Gila cypha*)  
 Crane, whooping (*Grus americana*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Ferret, black-footed (*Mustela nigripes*)  
 Flycatcher, Southwestern willow (*Empidonax traillii extimus*)  
 Owl, Mexican spotted (*Strix occidentalis lucida*)  
 Plover, piping (*Charadrius melodus*)  
 Skipper, Pawnee montane (*Hesperia leonardus* (=pawnee) montana)  
 Squawfish, Colorado (*Ptychocheilus lucius*)  
 Sucker, razorback (*Xyrauchen texanus*)  
 Tern, least (*Sterna antillarum*)  
 Trout, greenback cutthroat (*Oncorhynchus* (=Salmo) clarki stomias)  
 Wolf, gray (*Canis lupus*)

#### Plants--12 species

Clay-loving wild-buckwheat (*Eriogonum pelinophilum*)  
 Dudley Bluffs bladderpod (*Lesquerella congesta*)  
 Dudley Bluffs twinpod (*Physaria obcordata*)  
 Knowlton cactus (*Pediocactus knowltonii*)  
 Mancos milk-vetch (*Astragalus humillimus*)  
 Mesa Verde cactus (*Sclerocactus mesae-verdae*)  
 North Park phacelia (*Phacelia formosula*)  
 Osterhout milk-vetch (*Astragalus osterhoutii*)  
 Penland alpine fen mustard (*Eutrema penlandii*)  
 Penland beardtongue (*Penstemon penlandii*)  
 Uinta Basin hookless cactus (*Sclerocactus glaucus*)  
 Ute ladies'-tresses (*Spiranthes diluvialis*)

#### Connecticut--14 species

##### Animals--12 species

Beetle, Puritan tiger (*Cicindela puritana*)  
 Beetle, northeastern beach tiger (*Cicindela dorsalis dorsalis*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Mussel, dwarf wedge (*Alasmidonta heterodon*)  
 Plover, piping (*Charadrius melodus*)  
 Tern, roseate (*Sterna dougallii dougallii*)  
 Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, hawksbill sea (*Eretmochelys imbricata*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, loggerhead sea (*Caretta caretta*)

##### Plants--2 species

Sandplain gerardia (*Agalinis acuta*)  
 Small whorled pogonia (*Isotria medeoloides*)

#### Delaware--13 species

##### Animals--9 species

Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Plover, piping (*Charadrius melodus*)  
 Squirrel, Delmarva Peninsula fox (*Sciurus niger cinereus*)  
 Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, hawksbill sea (*Eretmochelys imbricata*)

Turtle, leatherback sea (*Dermochelys coriacea*)  
Turtle, loggerhead sea (*Caretta caretta*)

#### Plants--4 species

Canby's dropwort (*Oxypolis canbyi*)  
Knieskern's beaked-rush (*Rhynchospora knieskernii*)  
Small whorled pogonia (*Isotria medeoloides*)  
Swamp pink (*Helonias bullata*)

#### Florida--93 species

##### Animals--39 species

Bat, gray (*Myotis grisescens*)  
Butterfly, Schaus swallowtail (*Heraclides (=Papilio) aristodemus ponceanus*)  
Caracara, Audubon's crested (*Polyborus plancus audubonii*)  
Crocodile, American (*Crocodylus acutus*)  
Darter, Okaloosa (*Etheostoma okaloosae*)  
Deer, key (*Odocoileus virginianus clavium*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Jay, Florida scrub (*Aphelocoma coerulescens coerulescens*)  
Kite, Everglade snail (*Rostrhamus sociabilis plumbeus*)  
Manatee, West Indian (=Florida) (*Trichechus manatus*)  
Mouse, Anastasia Island beach (*Peromyscus polionotus phasma*)  
Mouse, Choctawhatchee beach (*Peromyscus polionotus allophrys*)  
Mouse, Key Largo cotton (*Peromyscus gossypinus allapaticola*)  
Mouse, Perdido Key beach (*Peromyscus polionotus trissyllepsis*)  
Mouse, southeastern beach (*Peromyscus polionotus niveiventris*)  
Panther, Florida (*Felis concolor coryi*)  
Plover, piping (*Charadrius melodus*)  
Rabbit, Lower Keys (*Sylvilagus palustris hefneri*)  
Rice rat (=silver rice rat) (*Oryzomys palustris natator*)  
Shrimp, Squirrel Chimney Cave (=Florida cave) (*Palaemonetes cummingsi*)  
Skink, bluetail (=blue-tailed) mole (*Eumeces egregius lividus*)  
Skink, sand (*Neoseps reynoldsi*)  
Snail, Stock Island tree (*Orthalicus reses* (not incl. *nesodryas*))  
Snake, Atlantic salt marsh (*Nerodia clarkii taeniata*)  
Snake, eastern indigo (*Drymarchon corais couperi*)  
Sparrow, Cape Sable seaside (*Ammodramus maritimus mirabilis*)  
Sparrow, Florida grasshopper (*Ammodramus savannarum floridanus*)  
Stork, wood (*Mycteria americana*)  
Sturgeon, Gulf (*Acipenser oxyrhynchus desotoi*)  
Tern, roseate (*Sterna dougallii dougallii*)  
Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
Turtle, green sea (*Chelonia mydas*)  
Turtle, hawksbill sea (*Eretmochelys imbricata*)  
Turtle, leatherback sea (*Dermochelys coriacea*)  
Turtle, loggerhead sea (*Caretta caretta*)  
Vole, Florida salt marsh (*Microtus pennsylvanicus dukecampbelli*)  
Woodpecker, red-cockaded (*Picoides borealis*)  
Woodrat, Key Largo (*Neotoma floridana smalli*)

##### Plants--54 species

American chaffseed (*Schwalbea americana*)  
Apalachicola rosemary (*Conradina glabra*)  
Avon Park harebells (*Crotalaria avonensis*)  
Beach jacquemontia (*Jacquemontia reclinata*)  
Beautiful pawpaw (*Deeringothamnus pulchellus*)  
Britton's beargrass (*Nolina brittoniana*)  
Brooksville (=Robins') bellflower (*Campanula robinsiae*)  
Carter's mustard (*Warea carteri*)  
Chapman rhododendron (*Rhododendron chapmanii*)

Cooley's meadowrue (*Thalictrum cooleyi*)  
 Cooley's water-willow (*Justicia cooleyi*)  
 Crenulate lead-plant (*Amorpha crenulata*)  
 Deltoid spurge (*Chamaesyce deltoidea* ssp. *deltoidea*)  
 Etonia rosemary (*Conradina etonia*)  
 Florida bonamia (*Bonamia grandiflora*)  
 Florida golden aster (*Chrysopsis floridana*)  
 Florida perforate cladonia (*Cladonia perforata*)  
 Florida skullcap (*Scutellaria floridana*)  
 Florida torreyia (*Torreya taxifolia*)  
 Florida ziziphus (*Ziziphus celata*)  
 Four-petal pawpaw (*Asimina tetramera*)  
 Fragrant prickly-apple (*Cereus eriophorus* var. *fragrans*)  
 Fringed campion (*Silene polypetala*)  
 Garber's spurge (*Chamaesyce garberi*)  
 Garrett's mint (*Dicerandra christmanii*)  
 Gentian pinkroot (*Spigelia gentianoides*)  
 Godfrey's butterwort (*Pinguicula ionantha*)  
 Harper's beauty (*Harperocallis flava*)  
 Highlands scrub hypericum (*Hypericum cumulicola*)  
 Key tree-cactus (*Pilosocereus robinii* (= *Cereus* r.))  
 Lakela's mint (*Dicerandra immaculata*)  
 Lewton's polygala (*Polygala lewtonii*)  
 Longspurred mint (*Dicerandra cornutissima*)  
 Miccosukee gooseberry (*Ribes echinellum*)  
 Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeensis*)  
 Papery whitlow-wort (*Paronychia chartacea*)  
 Pigeon wings (*Clitoria fragrans*)  
 Pondberry (*Lindera melissifolia*)  
 Pygmy fringe-tree (*Chionanthus pygmaeus*)  
 Rugel's pawpaw (*Deeringothamnus rugelii*)  
 Sandlace (*Polygonella myriophylla*)  
 Scrub blazingstar (*Liatris ohlingerae*)  
 Scrub buckwheat (*Eriogonum longifolium* var. *gnaphalifolium*)  
 Scrub lupine (*Lupinus aridorum*)  
 Scrub mint (*Dicerandra frutescens*)  
 Scrub plum (*Prunus geniculata*)  
 Short-leaved rosemary (*Conradina brevifolia*)  
 Small's milkpea (*Galactia smallii*)  
 Snakeroot (*Eryngium cuneifolium*)  
 Telephus spurge (*Euphorbia telephioides*)  
 Tiny polygala (*Polygala smallii*)  
 White birds-in-a-nest (*Machbridea alba*)  
 Wide-leaf warea (*Warea amplexifolia*)  
 Wireweed (*Polygonella basiramia*)

#### Georgia--51 species

##### Animals--30 species

Acornshell, southern (*Epioblasma othcaloogensis*)  
 Bat, Indiana (*Myotis sodalis*)  
 Bat, gray (*Myotis grisescens*)  
 Clubshell, ovate (*Pleurobema perovatum*)  
 Clubshell, southern (*Pleurobema decisum*)  
 Combshell, upland (*Epioblasma metastriata*)  
 Darter, Cherokee (*Etheostoma (Ulocentra) sp.*)  
 Darter, Etowah (*Etheostoma etowahae*)  
 Darter, amber (*Percina antesella*)  
 Darter, goldline (*Percina aurolineata*)  
 Darter, snail (*Percina tanasi*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Kidneyshell, triangular (*Ptychobranthus greeni*)  
 Logperch, Conasauga (*Percina jenkinsi*)  
 Manatee, West Indian (=Florida) (*Trichechus manatus*)

Moccasinshell, Alabama (*Medionidus acutissimus*)  
 Moccasinshell, Coosa (*Medionidus parvulus*)  
 Noddy, southern (*Pleurobema georgianum*)  
 Plover, piping (*Charadrius melodus*)  
 Pocketbook, fine-lined (*Lampsilis altilis*)  
 Shiner, blue (*Cyprinella* (= *Notropis*) *caerulea*)  
 Snake, eastern indigo (*Drymarchon corais couperi*)  
 Stork, wood (*Mycteria americana*)  
 Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, hawksbill sea (*Eretmochelys imbricata*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, loggerhead sea (*Caretta caretta*)  
 Woodpecker, red-cockaded (*Picoides borealis*)

#### Plants--21 species

American chaffseed (*Schwalbea americana*)  
 Black-spored quillwort (*Isoetes melanospora*)  
 Canby's dropwort (*Oxypolis canbyi*)  
 Florida torreyia (*Torreya taxifolia*)  
 Fringed campion (*Silene polypetala*)  
 Green pitcher-plant (*Sarracenia oreophila*)  
 Hairy rattleweed (*Baptisia arachnifera*)  
 Harperella (*Ptilimnium nodosum* (= *fluviatile*))  
 Large-flowered skullcap (*Scutellaria montana*)  
 Little amphianthus (*Amphianthus pusillus*)  
 Mat-forming quillwort (*Isoetes tegetiformans*)  
 Michaux's sumac (*Rhus michauxii*)  
 Mohr's Barbara's buttons (*Marshallia mohrii*)  
 Persistent trillium (*Trillium persistens*)  
 Pondberry (*Lindera melissifolia*)  
 Prickly trillium (*Trillium reliquum*)  
 Small whorled pogonia (*Isotria medeoloides*)  
 Smooth cone-flower (*Echinacea laevigata*)  
 Swamp pink (*Helonias bullata*)  
 Tennessee yellow-eyed grass (*Xyris tennesseensis*)  
 Virginia spiraea (*Spiraea virginiana*)

#### Hawaii--222 species

##### Animals--37 species

Bat, Hawaiian hoary (*Lasiurus cinereus semotus*)  
 Coot, Hawaiian (= 'alae-ke'oke'o) (*Fulica americana alai*)  
 Creeper, Hawaii (*Oreomystis mana*)  
 Creeper, Molokai (=kakawahie) (*Paroreomyza flammea*)  
 Creeper, Oahu (=alauwahio) (*Paroreomyza maculata*)  
 Crow, Hawaiian (= 'alala) (*Corvus hawaiiensis*)  
 Duck, Hawaiian (=koloa) (*Anas wyvilliana*)  
 Duck, Laysan (*Anas laysanensis*)  
 Finch, Laysan (honeycreeper) (*Telespyza cantans*)  
 Finch, Nihoa (honeycreeper) (*Telespyza ultima*)  
 Goose, Hawaiian (=nene) (*Nesochen sandvicensis*)  
 Hawk, Hawaiian (=io) (*Buteo solitarius*)  
 Honeycreeper, crested (= 'akohekohe) (*Palmeria dolei*)  
 Millerbird, Nihoa (old world warbler) (*Acrocephalus familiaris kingi*)  
 Moorhen (=gallinule), Hawaiian common (*Gallinula chloropus sandvicensis*)  
 Nukupu'u (honeycreeper) (*Hemignathus lucidus*)  
 Palila (honeycreeper) (*Loxioides bailleui*)  
 Parrotbill, Maui (honeycreeper) (*Pseudonestor xanthophrys*)  
 Petrel, Hawaiian dark-rumped (*Pterodroma phaeopygia sandwichensis*)  
 Pooouli (honeycreeper) (*Melamprosops phaeosoma*)  
 Shearwater, Newell's Townsend's (formerly Manx) (= 'a'o) (*Puffinus auricularis newelli*)

Snails, Oahu tree (*Achatinella* spp.)  
 T, Hawaiian (=ae'o) (*Himantopus mexicanus knudseni*)  
 Thrush, Molokai (=oloma'o) (*Myadestes lanaiensis rutha*)  
 Thrush, large Kauai (*Myadestes myadestinus*)  
 Thrush, small Kauai (=puaiohi) (*Myadestes palmeri*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, hawksbill sea (*Eretmochelys imbricata*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, loggerhead sea (*Caretta caretta*)  
 Turtle, olive (=Pacific) ridley sea (*Lepidochelys olivacea*)  
 Akepa, Hawaii (honeycreeper) (*Loxops coccineus coccineus*)  
 Akepa, Maui (honeycreeper) (*Loxops coccineus ochraceus*)  
 Akialoa, Kauai (honeycreeper) (*Hemignathus procerus*)  
 Akiapola'au (honeycreeper) (*Hemignathus munroi*)  
 O'o, Kauai (=o'o 'a-a) (honeyeater) (*Moho braccatus*)  
 O'u (honeycreeper) (*Psittirostra psittacea*)

#### Plants--185 species

*Abutilon eremitopetalum* (Plant, no common name)  
*Abutilon sandwicense* (Plant, no common name)  
*Alsinidendron obovatum* (Plant, no common name)  
*Alsinidendron trinerve* (Plant, no common name)  
*Asplenium fragile* var. *insulare* (Plant, no common name)  
*Bonamia menziesii* (Plant, no common name)  
*Chamaesyce halemanui* (Plant, no common name)  
*Cyanea macrostegia* ssp. *gibsonii* (Plant, no common name)  
*Cyanea superba* (Plant, no common name)  
*Cyanea undulata* (Plant, no common name)  
*Delissea rhytidosperra* (Plant, no common name)  
*Diellia falcata* (Plant, no common name)  
*Diellia pallida* (Plant, no common name)  
*Diellia unisora* (Plant, no common name)  
*Plazium molokaiense* (Plant, no common name)  
*Dubautia latifolia* (Plant, no common name)  
*Dubautia pauciflorula* (Plant, no common name)  
*Gahnia lanaiensis* (Plant, no common name)  
*Gouania hillebrandii* (Plant, no common name)  
*Gouania meyenii* (Plant, no common name)  
*Gouania vitifolia* (Plant, no common name)  
*Haplostachys haplostachya* var. *angustifolia* (Plant, no common name)  
*Hedyotis degeneri* (Plant, no common name)  
*Hedyotis parvula* (Plant, no common name)  
*Hesperomannia arborescens* (Plant, no common name)  
*Hesperomannia arbuscula* (Plant, no common name)  
*Hesperomannia lydgatei* (Plant, no common name)  
*Lipochaeta venosa* (Plant, no common name)  
*Lobelia niihauensis* (Plant, no common name)  
*Lobelia oahuensis* (Plant, no common name)  
*Lysimachia filifolia* (Plant, no common name)  
*Lysimachia lydgatei* (Plant, no common name)  
*Mariscus fauriei* (Plant, no common name)  
*Mariscus pennatifolius* (Plant, no common name)  
*Munroidendron racemosum* (Plant, no common name)  
*Neraudia angulata* (Plant, no common name)  
*Neraudia sericea* (Plant, no common name)  
*Phyllostegia glabra* var. *lanaiensis* (Plant, no common name)  
*Phyllostegia mannii* (Plant, no common name)  
*Phyllostegia mollis* (Plant, no common name)  
*Phyllostegia waimeae* (Plant, no common name)  
*Poa siphonoglossa* (Plant, no common name)  
*Pteris lidgatei* (Plant, no common name)  
*Remya kauaiensis* (Plant, no common name)  
*Remya montgomeryi* (Plant, no common name)  
*Ullandia crispa* (Plant, no common name)  
*Utricularia maritima* (Plant, no common name)  
*Schiedea haleakalensis* (Plant, no common name)

Schiedea kaalae (Plant, no common name)  
 Schiedea lydgatei (Plant, no common name)  
 Schiedea spargulina var. leiopoda (Plant, no common name)  
 Schiedea spargulina var. spargulina (Plant, no common name)  
 Silene alexandri (Plant, no common name)  
 Silene hawaiiensis (Plant, no common name)  
 Silene lanceolata (Plant, no common name)  
 Silene perlmannii (Plant, no common name)  
 Spermolepis hawaiiensis (Plant, no common name)  
 Stenogyne angustifolia var. angustifolia (Plant, no common name)  
 Stenogyne bifida (Plant, no common name)  
 Stenogyne campanulata (Plant, no common name)  
 Stenogyne kanehoana (Plant, no common name)  
 Tetramolopium arenarium (Plant, no common name)  
 Tetramolopium filiforme (Plant, no common name)  
 Tetramolopium lepidotum ssp. lepidotum (Plant, no common name)  
 Tetramolopium remyi (Plant, no common name)  
 Tetramolopium rockii (Plant, no common name)  
 Vigna o-wahuensis (Plant, no common name)  
 Viola helenae (Plant, no common name)  
 Viola lanaiensis (Plant, no common name)  
 Xylosma crenatum (Plant, no common name)  
 A'e (Zanthoxylum hawaiiense)  
 Alani (Melicope adscendens)  
 Alani (Melicope balloui)  
 Alani (Melicope haupuensis)  
 Alani (Melicope knudsenii)  
 Alani (Melicope lydgatei)  
 Alani (Melicope mucronulata)  
 Alani (Melicope ovalis)  
 Alani (Melicope pallida)  
 Alani (Melicope quadrangularis)  
 Alani (Melicope reflexa)  
 Plenum-leaved diellia (Diellia erecta)  
 Naupaka (Isodendron hosakae)  
 Carter's panicgrass (Panicum fauriei var. carteri)  
 Clay's hibiscus (Hibiscus clayi)  
 Cooke's koki'o (Kokia cookei)  
 Cuneate bidens (Bidens cuneata)  
 Diamond Head schiedea (Schiedea adamantis)  
 Dwarf iliau (Wilkesia hobbeyi)  
 Dwarf naupaka (Scaevola coriacea)  
 Fern, pendant kihi (Adenophorus periens)  
 Ha'iwale (Cyrtandra crenata)  
 Ha'iwale (Cyrtandra giffardii)  
 Ha'iwale (Cyrtandra limahuliensis)  
 Ha'iwale (Cyrtandra munroi)  
 Ha'iwale (Cyrtandra polyantha)  
 Ha'iwale (Cyrtandra tintinnabula)  
 Haha (Cyanea asarifolia)  
 Haha (Cyanea copelandii ssp. copelandii)  
 Haha (Cyanea grimesiana ssp. obatae)  
 Haha (Cyanea hamatiflora ssp. carlsonii)  
 Haha (Cyanea lobata)  
 Haha (Cyanea mannii)  
 Haha (Cyanea mceldowneyi)  
 Haha (Cyanea pinnatifida)  
 Haha (Cyanea procera)  
 Haha (Cyanea shipmannii)  
 Haha (Cyanea stictophylla)  
 Haha (Cyanea truncata)  
 Hawaiian bluegrass (Poa sandwicensis)  
 Hawaiian red-flowered geranium (Geranium arboreum)  
 Hawaiian vetch (Vicia menziesii)  
 Mau (Exocarpos luteolus)  
 Alo ischaemum (Ischaemum byrone)  
 Molei (Ochrosia kilaueaensis)

Ihi ihi (*Marsilea villosa*)  
 Kau silversword (*Argyroxiphium kauense*)  
 Makahala (*Labordia lydgatei*)  
 Kauai hau kuahiwi (*Hibiscadelphus distans*)  
 Kauula (*Colubrina oppositifolia*)  
 Kaulu (*Pteralyxia kauaiensis*)  
 Kio'ele (*Hedyotis coriacea*)  
 Ko'oko'olau (*Bidens micrantha* ssp. *kalealaha*)  
 Ko'oko'olau (*Bidens wiebkei*)  
 Ko'olua'ula (*Abutilon menziesii*)  
 Koki'o (=hau-hele'ula or Hawaii tree cotton) (*Kokia drynarioides*)  
 Koki'o ke'oke'o (*Hibiscus arnottianus* ssp. *immaculatus*)  
 Kulu'i (*Nototrichium humile*)  
 Lanai sandalwood or 'iliahi (*Santalum freycinetianum* var. *lanaiense*)  
 Laukahi kuahiwi (*Plantago hawaiiensis*)  
 Laukahi kuahiwi (*Plantago princeps*)  
 Liliwai (*Acaena exigua*)  
 Loulu (*Pritchardia affinis*)  
 Loulu (*Pritchardia munroi*)  
 Ma'o hau hele (*Hibiscus brackenridgei*)  
 Ma'oli'oli (*Schiedea apokremnos*)  
 Mahoe (*Alectryon macrococcus*)  
 Makou (*Peucedanum sandwicense*)  
 Mann's bluegrass (*Poa mannii*)  
 Maui remya (*Remya mauensis*)  
 Mehamehame (*Flueggea neowawraea*)  
 Na Pali beach hedyotis (*Hedyotis* st.-johnii)  
 Na'ena'e (*Dubautia herbstobatae*)  
 Na'u or Hawaiian gardenia (*Gardenia brighamii*)  
 Nehe (*Lipochaeta fauriei*)  
 Nehe (*Lipochaeta kamolensis*)  
 Nehe (*Lipochaeta lobata* var. *leptophylla*)  
 Nehe (*Lipochaeta micrantha*)  
 Nehe (*Lipochaeta tenuifolia*)  
 Nehe (*Lipochaeta waimeaensis*)  
 Nioi (*Eugenia koolauensis*)  
 Nohoanu (*Geranium multiflorum*)  
 Opuhe (*Urera kaalae*)  
 Pamakani (*Tetramolopium capillare*)  
 Pamakani (*Viola chamissoniana chamissoniana*)  
 Pauoa (*Ctenitis squamigera*)  
 Pilo (*Hedyotis mannii*)  
 Po'e (*Portulaca sclerocarpa*)  
 Popolo ku mai (*Solanum incompletum*)  
 Pua'ala (*Brighamia rockii*)  
 Round-leaved chaff-flower (*Achyranthes splendens* var. *rotundata*)  
 Uhiuhi (*Caesalpinia kavaiense*)  
 Wahine noho kula (*Isodendron pyrifolium*)  
 Wawae'iole (*Huperzia mannii*)  
 Wawae'iole (*Lycopodium nutans*)  
 'Ahinahina (=Haleakala silversword) (*Argyroxiphium sandwicense* ssp. *macrocephalum*)  
 'Ahinahina (=Mauna Kea silversword) (*Argyroxiphium sandwicense* ssp. *sandwicense*)  
 'Aiakeakua, popolo (*Solanum sandwicense*)  
 'Aiea (*Nothocestrum breviflorum*)  
 'Aiea (*Nothocestrum peltatum*)  
 'Akoko (*Chamaesyce celastroides* var. *kaenana*)  
 'Akoko (*Chamaesyce deppeana* (=Euphorbia d.))  
 'Akoko (*Chamaesyce kuwaleana*)  
 'Awikiwiki (*Canavalia molokaiensis*)  
 'Awiwi (*Centaurium sebaeoides*)  
 'Awiwi (*Hedyotis cookiana*)  
 Ewa Plains 'akoko (*Chamaesyce skottsbergii* var. *kalaeloana*)  
 'Oha wai (*Clermontia lindseyana*)  
 'Oha wai (*Clermontia oblongifolia* ssp. *brevipes*)  
 'Oha wai (*Clermontia oblongifolia* ssp. *mauiensis*)

Ohia wai (*Clermontia peleana*)  
Ohia wai (*Clermontia pyralaria*)  
Ohia wai (*Sesbania tomentosa*)  
Ohe'ohe (*Tetraplasandra gymnocarpa*)  
Olulu (*Brighamia insignis*)

Idaho--15 species

Animals--13 species

Bear, grizzly (*Ursus arctos*)  
Caribou, woodland (*Rangifer tarandus caribou*)  
Crane, whooping (*Grus americana*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Limpet, Banbury Springs (*Lanx* sp.)  
Snail, Bliss Rapids (*Taylorconcha serpenticola*)  
Snail, Snake River physa (*Physa natricina*)  
Snail, Utah valvata (*Valvata utahensis*)  
Springsnail, Bruneau Hot (*Pyrgulopsis bruneauensis*)  
Springsnail, Idaho (*Fontelicella idahoensis*)  
Sturgeon, white (Kootenai River pop.) (*Acipenser transmontanus*)  
Wolf, gray (*Canis lupus*)

Plants--2 species

MacFarlane's four-o'clock (*Mirabilis macfarlanei*)  
Water howellia (*Howellia aquatilis*)

Illinois--24 species

Animals--16 species

Bat, Indiana (*Myotis sodalis*)  
Bat, gray (*Myotis grisescens*)  
Butterfly, Karner blue (*Lycaeides melissa samuelis*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Fanshell (*Cyprogenia stegaria*)  
Hine's emerald dragonfly (*Somatochlora hineana*)  
Pearlymussel, Higgins' eye (*Lampsilis higginsii*)  
Pearlymussel, orange-foot pimple back (*Plethobasus cooperianus*)  
Pearlymussel, white wartyback (*Plethobasus cicatricosus*)  
Plover, piping (*Charadrius melodus*)  
Pocketbook, fat (*Potamilus (=Proptera) capax*)  
Snail, Iowa Pleistocene (*Discus macclintocki*)  
Sturgeon, pallid (*Scaphirhynchus albus*)  
Tern, least (*Sterna antillarum*)  
Warbler, Kirtland's (*Dendroica kirtlandii*)

Plants--8 species

Decurrent false aster (*Boltonia decurrens*)  
Eastern prairie fringed orchid (*Platanthera leucophaea*)  
Lakeside daisy (*Hymenoxys herbacea*)  
Leafy prairie-clover (*Dalea (=Petalostemum) foliosa*)  
Mead's milkweed (*Asclepias meadii*)  
Pitcher's thistle (*Cirsium pitcheri*)  
Prairie bush-clover (*Lespedeza leptostachya*)  
Small whorled pogonia (*Isotria medeoloides*)

Indiana--20 species

Animals--17 species

Bat, Indiana (*Myotis sodalis*)  
 Bat, gray (*Myotis grisescens*)  
 Butterfly, Karner blue (*Lycia melissa samuelis*)  
 Butterfly, Mitchell's satyr (*Neonympha mitchellii mitchellii*)  
 Clubshell (*Pleurobema clava*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Fanshell (*Cyprogenia stegaria*)  
 Mussel, ring pink (=golf stick pearly) (*Obovaria retusa*)  
 Pearlymussel, orange-foot pimple back (*Plethobasus cooperianus*)  
 Pearlymussel, tubercled-blossom (*Epioblasma torulosa torulosa*)  
 Pearlymussel, white cat's paw (*Epioblasma obliquata perobliqua* (=sulcata delicata))  
 Pearlymussel, white wartyback (*Plethobasus cicatricosus*)  
 Pigtoe, rough (*Pleurobema plenum*)  
 Plover, piping (*Charadrius melodus*)  
 Pocketbook, fat (*Potamilus* (=Proptera) capax)  
 Tern, least (*Sterna antillarum*)

Plants--3 species

Mead's milkweed (*Asclepias meadii*)  
 Pitcher's thistle (*Cirsium pitcheri*)  
 Running buffalo clover (*Trifolium stoloniferum*)

Iowa--14 species

Animals--9 species

Bat, Indiana (*Myotis sodalis*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Pearlymussel, Higgins' eye (*Lampsilis higginsii*)  
 Plover, piping (*Charadrius melodus*)  
 Pocketbook, fat (*Potamilus* (=Proptera) capax)  
 Snail, Iowa Pleistocene (*Discus macclintocki*)  
 Sturgeon, pallid (*Scaphirhynchus albus*)  
 Tern, least (*Sterna antillarum*)

Plants--5 species

Eastern prairie fringed orchid (*Platanthera leucophaea*)  
 Mead's milkweed (*Asclepias meadii*)  
 Northern wild monkshood (*Aconitum noveboracense*)  
 Prairie bush-clover (*Lespedeza leptostachya*)  
 Western prairie fringed orchid (*Platanthera praeclara*)

Kansas--14 species

Animals--12 species

Bat, Indiana (*Myotis sodalis*)  
 Bat, gray (*Myotis grisescens*)  
 Crane, whooping (*Grus americana*)  
 Curlew, Eskimo (*Numenius borealis*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Ferret, black-footed (*Mustela nigripes*)  
 Madtom, Neosho (*Noturus placidus*)  
 Plover, piping (*Charadrius melodus*)  
 Sturgeon, pallid (*Scaphirhynchus albus*)  
 Tern, least (*Sterna antillarum*)  
 Vireo, black-capped (*Vireo atricapillus*)

Florida--2 species

Mead's milkweed (*Asclepias meadii*)  
Western prairie fringed orchid (*Platanthera praeclara*)

Kentucky--38 species

Animals--30 species

Bat, Indiana (*Myotis sodalis*)  
Bat, Virginia big-eared (*Plecotus townsendii virginianus*)  
Bat, gray (*Myotis grisescens*)  
Clubshell (*Pleurobema clava*)  
Dace, blackside (*Phoxinus cumberlandensis*)  
Darter, relict (*Etheostoma (Catonotus) chienense*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Fanshell (*Cyprogenia stegaria*)  
Mussel, ring pink (=golf stick pearly) (*Obovaria retusa*)  
Mussel, winged mapleleaf (*Quadrula fragosa*)  
Pearlymussel, Cumberland bean (*Villosa trabalis*)  
Pearlymussel, cracking (*Hemistena lata*)  
Pearlymussel, dromedary (*Dromus dromas*)  
Pearlymussel, little-wing (*Pegias fabula*)  
Pearlymussel, orange-foot pimple back (*Plethobasus cooperianus*)  
Pearlymussel, pink mucket (*Lampsilis abrupta*)  
Pearlymussel, purple cat's paw (*Epioblasma obliquata obliquata*)  
Pearlymussel, tubercled-blossom (*Epioblasma torulosa torulosa*)  
Pearlymussel, white wartyback (*Plethobasus cicatricosus*)  
Pillbug, rough (*Pleurobema plenum*)  
Pipit, piping (*Charadrius melodus*)  
Pocketbook, fat (*Potamilus (=Proptera) capax*)  
Riffleshell, northern (*Epioblasma torulosa rangiana*)  
Riffleshell, tan (*Epioblasma walkeri*)  
Shiner, Palezone (*Notropis* sp.)  
Shrimp, Kentucky cave (*Palaemonias ganteri*)  
Sturgeon, pallid (*Scaphirhynchus albus*)  
Tern, least (*Sterna antillarum*)  
Woodpecker, red-cockaded (*Picoides borealis*)

Plants--8 species

Cumberland rosemary (*Conradina verticillata*)  
Cumberland sandwort (*Arenaria cumberlandensis*)  
Price's potato-bean (*Apios priceana*)  
Rock cress (*Arabis perstellata*)  
Running buffalo clover (*Trifolium stoloniferum*)  
Short's goldenrod (*Solidago shortii*)  
Virginia spiraea (*Spiraea virginiana*)  
White-haired goldenrod (*Solidago albopilosa*)

Louisiana--25 species

Animals--21 species

Bear, Louisiana black (*Ursus americanus luteolus*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Heelsplitter, inflated (*Potamilus inflatus*)  
Jadeite, West Indian (=Florida) (*Trichechus manatus*)  
Larval shell, Louisiana (*Margaritifera hembeli*)  
Pearlymussel, pink mucket (*Lampsilis abrupta*)

Pelican, brown (*Pelecanus occidentalis*)  
 Plover, piping (*Charadrius melodus*)  
 Sturgeon, Gulf (*Acipenser oxyrinchus desotoi*)  
 Sturgeon, pallid (*Scaphirhynchus albus*)  
 Tern, least (*Sterna antillarum*)  
 Tortoise, gopher (*Gopherus polyphemus*)  
 Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, hawksbill sea (*Eretmochelys imbricata*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, loggerhead sea (*Caretta caretta*)  
 Turtle, ringed map (=sawback) (*Graptemys oculifera*)  
 Vireo, black-capped (*Vireo atricapillus*)  
 Woodpecker, red-cockaded (*Picoides borealis*)

#### Plants--4 species

Geocarpon minimum (Plant, no common name)  
 American chaffseed (*Schwalbea americana*)  
 Louisiana quillwort (*Isoetes louisianensis*)  
 Pondberry (*Lindera melissifolia*)

#### Maine--8 species

##### Animals--5 species

Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Plover, piping (*Charadrius melodus*)  
 Tern, roseate (*Sterna dougallii dougallii*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)

##### Plants--3 species

Eastern prairie fringed orchid (*Platanthera leucophaea*)  
 Furbish lousewort (*Pedicularis furbishiae*)  
 Small whorled pogonia (*Isotria medeoloides*)

#### Maryland--20 species

##### Animals--14 species

Bat, Indiana (*Myotis sodalis*)  
 Beetle, Puritan tiger (*Cicindela puritana*)  
 Beetle, northeastern beach tiger (*Cicindela dorsalis dorsalis*)  
 Darter, Maryland (*Etheostoma sellare*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Mussel, dwarf wedge (*Alasmidonta heterodon*)  
 Plover, piping (*Charadrius melodus*)  
 Squirrel, Delmarva Peninsula fox (*Sciurus niger cinereus*)  
 Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, hawksbill sea (*Eretmochelys imbricata*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, loggerhead sea (*Caretta caretta*)

##### Plants--6 species

Canby's dropwort (*Oxypolis canbyi*)  
 Harperella (*Ptilimnium nodosum* (=fluviatile))  
 Northeastern (=Barbed bristle) bulrush (*Scirpus ancistrochaetus*)  
 Sandplain gerardia (*Agalinis acuta*)  
 Sensitive joint-vetch (*Aeschynomene virginica*)  
 Swamp pink (*Helonias bullata*)

Massachusetts--16 species

Animals--13 species

Beetle, American burying (=giant carrion) (*Nicrophorus americanus*)  
Beetle, Puritan tiger (*Cicindela puritana*)  
Beetle, northeastern beach tiger (*Cicindela dorsalis dorsalis*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Mussel, dwarf wedge (*Alasmidonta heterodon*)  
Plover, piping (*Charadrius melodus*)  
Tern, roseate (*Sterna dougallii dougallii*)  
Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
Turtle, Plymouth redbelly (=red-bellied) (*Pseudemys rubriventris bangs*  
1)  
Turtle, hawksbill sea (*Eretmochelys imbricata*)  
Turtle, leatherback sea (*Dermochelys coriacea*)  
Turtle, loggerhead sea (*Caretta caretta*)

Plants--3 species

Northeastern (=Barbed bristle) bulrush (*Scirpus ancistrochaetus*)  
Sandplain gerardia (*Agalinis acuta*)  
Small whorled pogonia (*Isotria medeoloides*)

Michigan--18 species

Animals--11 species

Beetle, Indiana (*Myotis sodalis*)  
Beetle, Hungerford's crawling water (*Brychius hungerfordi*)  
Butterfly, Karner blue (*Lycaeides melissa samuelis*)  
Butterfly, Mitchell's satyr (*Neonympha mitchellii mitchellii*)  
Clubshell (*Pleurobema clava*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Plover, piping (*Charadrius melodus*)  
Riffleshell, northern (*Epioblasma torulosa rangiana*)  
Warbler, Kirtland's (*Dendroica kirtlandii*)  
Wolf, gray (*Canis lupus*)

Plants--7 species

American hart's-tongue fern (*Asplenium scolopendrium* var. *americanum*)  
Dwarf lake iris (*Iris lacustris*)  
Eastern prairie fringed orchid (*Platanthera leucophaea*)  
Houghton's goldenrod (*Solidago houghtonii*)  
Michigan monkey-flower (*Mimulus glabratus* var. *michiganensis*)  
Pitcher's thistle (*Cirsium pitcheri*)  
Small whorled pogonia (*Isotria medeoloides*)

Minnesota--11 species

Animals--7 species

Butterfly, Karner blue (*Lycaeides melissa samuelis*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Mussel, winged mapleleaf (*Quadrula fragosa*)  
Earlymussel, Higgins' eye (*Lampsilis higginsii*)  
Plover, piping (*Charadrius melodus*)  
Wolf, gray (*Canis lupus*)

Plants--4 species

Leedy's roseroot (*Sedum integrifolium* ssp. *leedyi*)  
Minnesota trout lily (*Erythronium propullans*)  
Prairie bush-clover (*Lespedeza leptostachya*)  
Western prairie fringed orchid (*Platanthera praeclara*)

Mississippi--36 species

Animals--33 species

Bat, Indiana (*Myotis sodalis*)  
Bear, Louisiana black (*Ursus americanus luteolus*)  
Clubshell, black (=Curtus' mussel) (*Pleurobema curtum*)  
Clubshell, ovate (*Pleurobema perovatum*)  
Clubshell, southern (*Pleurobema decisum*)  
Combshell, southern (=penitent mussel) (*Epioblasma penita*)  
Crane, Mississippi sandhill (*Grus canadensis pulla*)  
Darter, bayou (*Etheostoma rubrum*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Heelsplitter, inflated (*Potamilus inflatus*)  
Manatee, West Indian (=Florida) (*Trichechus manatus*)  
Moccasinshell, Alabama (*Medionidus acutissimus*)  
Mucket, orange-nacre (*Lampsilis perovalis*)  
Pelican, brown (*Pelecanus occidentalis*)  
Pigtoe, flat (=Marshall's mussel) (*Pleurobema marshalli*)  
Pigtoe, heavy (=Judge Tait's mussel) (*Pleurobema taitianum*)  
Plover, piping (*Charadrius melodus*)  
Pocketbook, fat (*Potamilus* (=Proptera) *capax*)  
Ske, eastern indigo (*Drymarchon corais couperi*)  
Stirrups shell (*Quadrula stapes*)  
Sturgeon, Gulf (*Acipenser oxyrhynchus desotoi*)  
Sturgeon, pallid (*Scaphirhynchus albus*)  
Tern, least (*Sterna antillarum*)  
Tortoise, gopher (*Gopherus polyphemus*)  
Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
Turtle, green sea (*Chelonia mydas*)  
Turtle, hawksbill sea (*Eretmochelys imbricata*)  
Turtle, leatherback sea (*Dermochelys coriacea*)  
Turtle, loggerhead sea (*Caretta caretta*)  
Turtle, ringed map (=sawback) (*Graptemys oculifera*)  
Turtle, yellow-blotched map (=sawback) (*Graptemys flavimaculata*)  
Woodpecker, red-cockaded (*Picoides borealis*)

Plants--3 species

American chaffseed (*Schwalbea americana*)  
Pondberry (*Lindera melissifolia*)  
Price's potato-bean (*Apios priceana*)

Missouri--22 species

Animals--15 species

Bat, Indiana (*Myotis sodalis*)  
Bat, Ozark big-eared (*Plecotus townsendii ingens*)  
Bat, gray (*Myotis grisescens*)  
Cavefish, Ozark (*Amblyopsis rosae*)  
Darter, Niangua (*Etheostoma nianguae*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)

Madtom, Neosho (*Noturus placidus*)  
Earlymussel, Curtis' (*Epioblasma (=Dysnomia) florentina curtisi*)  
Earlymussel, Higgins' eye (*Lampsilis higginsii*)  
Pearlymussel, pink mucket (*Lampsilis abrupta*)  
Plover, piping (*Charadrius melodus*)  
Pocketbook, fat (*Potamilus (=Proptera) capax*)  
Sturgeon, pallid (*Scaphirhynchus albus*)  
Tern, least (*Sterna antillarum*)

Plants--7 species

Geocarpum minimum (Plant, no common name)  
Decurrent false aster (*Boltonia decurrens*)  
Mead's milkweed (*Asclepias meadii*)  
Missouri bladderpod (*Lesquerella filiformis*)  
Pondberry (*Lindera melissifolia*)  
Running buffalo clover (*Trifolium stoloniferum*)  
Western prairie fringed orchid (*Platanthera praeclara*)

Montana--12 species

Animals--11 species

Bear, grizzly (*Ursus arctos*)  
Crane, whooping (*Grus americana*)  
Curlew, Eskimo (*Numenius borealis*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Ferret, black-footed (*Mustela nigripes*)  
Plover, piping (*Charadrius melodus*)  
Sturgeon, pallid (*Scaphirhynchus albus*)  
Sturgeon, white (Kootenai River pop.) (*Acipenser transmontanus*)  
Tern, least (*Sterna antillarum*)  
Wolf, gray (*Canis lupus*)

Plants--1 species

Water howellia (*Howellia aquatilis*)

Nebraska--11 species

Animals--9 species

Beetle, American burying (=giant carrion) (*Nicrophorus americanus*)  
Crane, whooping (*Grus americana*)  
Curlew, Eskimo (*Numenius borealis*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Ferret, black-footed (*Mustela nigripes*)  
Plover, piping (*Charadrius melodus*)  
Sturgeon, pallid (*Scaphirhynchus albus*)  
Tern, least (*Sterna antillarum*)

Plants--2 species

Blowout penstemon (*Penstemon haydenii*)  
Western prairie fringed orchid (*Platanthera praeclara*)

Nevada--33 species

Animals--25 species

Chub, Pahrnagat roundtail (=bonytail) (*Gila robusta jordani*)  
Chub, Virgin River (*Gila robusta semidnuda*)

Chub, bonytail (*Gila elegans*)  
 Cui (Chasmistes cujus)  
 Dace, Ash Meadows speckled (*Rhinichthys osculus nevadensis*)  
 Dace, Clover Valley speckled (*Rhinichthys osculus oligoporus*)  
 Dace, Independence Valley speckled (*Rhinichthys osculus lethoporus*)  
 Dace, Moapa (*Moapa coriacea*)  
 Dace, desert (*Eremichthys acros*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Naucorid, Ash Meadows (*Ambrysus amargosus*)  
 Poolfishkillifish, Pahump (*Empetrichthys latos*)  
 Pupfish, Ash Meadows Amargosa (*Cyprinodon nevadensis mionectes*)  
 Pupfish, Devils Hole (*Cyprinodon diabolis*)  
 Pupfish, Warm Springs (*Cyprinodon nevadensis pectoralis*)  
 Spinedace, Big Spring (*Lepidomeda mollispinis pratensis*)  
 Spinedace, White River (*Lepidomeda albivallis*)  
 Springfish, Hiko White River (*Crenichthys baileyi grandis*)  
 Springfish, Railroad Valley (*Crenichthys nevadae*)  
 Springfish, White River (*Crenichthys baileyi baileyi*)  
 Sucker, razorback (*Xyrauchen texanus*)  
 Tortoise, desert (*Gopherus agassizii*)  
 Trout, Lahontan cutthroat (*Oncorhynchus* (=Salmo) *clarki henshawi*)  
 Woundfin (*Plagopterus argentissimus*)

#### Plants--8 species

Amargosa niterwort (*Nitrophila mohavensis*)  
 Ash Meadows blazing-star (*Mentzelia leucophylla*)  
 Ash Meadows gumplant (*Grindelia fraxino-pratensis*)  
 Ash Meadows ivesia (*Ivesia kingii* var. *eremica*)  
 Ash Meadows milk-vetch (*Astragalus phoenix*)  
 Ash Meadows sunray (*Enceliopsis nudicaulis* var. *corrugata*)  
 Ring-loving centaury (*Centaureum namophilum*)  
 Ramboat buckwheat (*Eriogonum ovalifolium* var. *williamsiae*)

#### New Hampshire--10 species

##### Animals--6 species

Beetle, Puritan tiger (*Cicindela puritana*)  
 Butterfly, Karner blue (*Lycaeides melissa samuelis*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Mussel, dwarf wedge (*Alasmidonta heterodon*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)

##### Plants--4 species

Jesup's milk-vetch (*Astragalus robbinsii* var. *jesupi*)  
 Northeastern (=Barbed bristle) bulrush (*Scirpus ancistrochaetus*)  
 Robbins' cinquefoil (*Potentilla robbinsiana*)  
 Small whorled pogonia (*Isotria medeoloides*)

#### New Jersey--15 species

##### Animals--10 species

Bat, Indiana (*Myotis sodalis*)  
 Beetle, northeastern beach tiger (*Cicindela dorsalis dorsalis*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Plover, piping (*Charadrius melodus*)  
 Tern, roseate (*Sterna dougallii dougallii*)  
 Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempi*)

Turtle, hawksbill sea (*Eretmochelys imbricata*)  
Turtle, leatherback sea (*Dermochelys coriacea*)  
Turtle, loggerhead sea (*Caretta caretta*)

#### Plants--5 species

American chaffseed (*Schwalbea americana*)  
Knieskern's beaked-rush (*Rhynchospora knieskernii*)  
Sensitive joint-vetch (*Aeschynomene virginica*)  
Small whorled pogonia (*Isotria medeoloides*)  
Swamp pink (*Helonias bullata*)

#### New Mexico--37 species

##### Animals--23 species

Bat, Mexican long-nosed (*Leptonycteris nivalis*)  
Bat, lesser (=Sanborn's) long-nosed (*Leptonycteris curasoae yerbabuena*)  
Chub, Chihuahua (*Gila nigrescens*)  
Crane, whooping (*Grus americana*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Flycatcher, Southwestern willow (*Empidonax traillii extimus*)  
Gambusia, Pecos (*Gambusia nobilis*)  
Isopod, Socorro (*Thermosphaeroma* (=Exosphaeroma) *thermophilus*)  
Minnow, Rio Grande silvery (*Hybognathus amarus*)  
Minnow, loach (*Rhinichthys* (=Tiaroga) *cobitis*)  
Owl, Mexican spotted (*Strix occidentalis lucida*)  
Rattlesnake, New Mexican ridge-nosed (*Crotalus willardi obscurus*)  
Shiner, Pecos bluntnose (*Notropis simus pecosensis*)  
Shiner, beautiful (*Cyprinella* (=Notropis) *formosa*)  
Skeedace (*Meda fulgida*)  
Springsnail, Alamosa (*Tryonia alamosae*)  
Springsnail, Socorro (*Pyrgulopsis neomexicana*)  
Sucker, razorback (*Xyrauchen texanus*)  
Tern, least (*Sterna antillarum*)  
Topminnow, Gila (incl. Yaqui) (*Poeciliopsis occidentalis*)  
Trout, Gila (*Oncorhynchus* (=Salmo) *gilae*)  
Woundfin (*Plagopterus argentissimus*)

##### Plants--14 species

Gypsum wild-buckwheat (*Eriogonum gypsophilum*)  
Holy Ghost ipomopsis (*Ipomopsis sancti-spiritus*)  
Knowlton cactus (*Pediocactus knowltonii*)  
Kuenzler hedgehog cactus (*Echinocereus fendleri* var. *kuenzleri*)  
Lee pincushion cactus (*Coryphantha sneedii* var. *leei*)  
Lloyd's Mariposa cactus (*Echinomastus* (=Sclerocactus) *mariposensis*)  
Lloyd's hedgehog cactus (*Echinocereus lloydii*)  
Mancos milk-vetch (*Astragalus humillimus*)  
Mesa Verde cactus (*Sclerocactus mesae-verdae*)  
Sacramento Mountains thistle (*Cirsium vinaceum*)  
Sacramento prickly-poppy (*Argemone pleiacantha* ssp. *pinnatisecta*)  
Sneed pincushion cactus (*Coryphantha sneedii* var. *sneedii*)  
Todsens pennyroyal (*Hedeoma todsenii*)  
Zuni (=rhizome) fleabane (*Erigeron rhizomatus*)

#### New York--19 species

##### Animals--12 species

Butterfly, Karner blue (*Lycaeides melissa samuelis*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)

Mussel, dwarf wedge (*Alasmidonta heterodon*)  
 Plover, piping (*Charadrius melodus*)  
 Shell, Chittenango ovate amber (*Succinea chittenangoensis*)  
 Tern, roseate (*Sterna dougallii dougallii*)  
 Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, hawksbill sea (*Eretmochelys imbricata*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, loggerhead sea (*Caretta caretta*)

#### Plants--7 species

American hart's-tongue fern (*Asplenium scolopendrium* var. *americanum*)  
 Houghton's goldenrod (*Solidago houghtonii*)  
 Leedy's roseroot (*Sedum integrifolium* ssp. *leedyi*)  
 Northeastern (=Barbed bristle) bulrush (*Scirpus ancistrochaetus*)  
 Northern wild monkshood (*Aconitum noveboracense*)  
 Sandplain gerardia (*Agalinis acuta*)  
 Seabeach amaranth (*Amaranthus pumilus*)

#### North Carolina--53 species

##### Animals--27 species

Bat, Indiana (*Myotis sodalis*)  
 Bat, Virginia big-eared (*Plecotus townsendii virginianus*)  
 Butterfly, Saint Francis' satyr (*Neonympha mitchellii francisci*)  
 Chub, spotfin (=turquoise shiner) (*Cyprinella* (=Hybopsis) *monacha*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Elktoe, Appalachian (*Alasmidonta raveneliana*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Hellsplitter, Carolina (*Lasmigona decorata*)  
 Manatee, West Indian (=Florida) (*Trichechus manatus*)  
 Mussel, dwarf wedge (*Alasmidonta heterodon*)  
 Pearlymussel, little-wing (*Pegias fabula*)  
 Plover, piping (*Charadrius melodus*)  
 Shiner, Cape Fear (*Notropis mekistocholas*)  
 Shrew, Dismal Swamp southeastern (*Sorex longirostris fisheri*)  
 Silverside, Waccamaw (*Menidia extensa*)  
 Snail, noonday (*Mesodon clarki nantahala*)  
 Spiny mussel, Tar River (*Elliptio steinstansana*)  
 Spruce-fir moss spider (*Microhexura montivaga*)  
 Squirrel, Carolina northern flying (*Glaucomys sabrinus coloratus*)  
 Tern, roseate (*Sterna dougallii dougallii*)  
 Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, hawksbill sea (*Eretmochelys imbricata*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, loggerhead sea (*Caretta caretta*)  
 Wolf, red (*Canis rufus*)  
 Woodpecker, red-cockaded (*Picoides borealis*)

##### Plants--26 species

American chaffseed (*Schwalbea americana*)  
 Blue Ridge goldenrod (*Solidago spithamea*)  
 Bunched arrowhead (*Sagittaria fasciculata*)  
 Canby's dropwort (*Oxypolis canbyi*)  
 Cooley's meadowrue (*Thalictrum cooleyi*)  
 Dwarf-flowered heartleaf (*Hexastylis naniflora*)  
 Green pitcher-plant (*Sarracenia oreophila*)  
 Harperella (*Ptilimnium nodosum* (=fluviatile))  
 Heller's blazingstar (*Liatris helleri*)  
 Michaux's sumac (*Rhus michauxii*)  
 Mountain golden heather (*Hudsonia montana*)  
 Mountain sweet pitcher-plant (*Sarracenia rubra* ssp. *jonesii*)

Pondberry (*Lindera melissifolia*)  
 Mountain bluet (*Hedyotis purpurea* var. *montana*)  
 Rock gnome lichen (*Gymnoderma lineare*)  
 Rough-leaved loosestrife (*Lysimachia asperulaefolia*)  
 Schweinitz's sunflower (*Helianthus schweinitzii*)  
 Seabeach amaranth (*Amaranthus pumilus*)  
 Sensitive joint-vetch (*Aeschynomene virginica*)  
 Small whorled pogonia (*Isotria medeoloides*)  
 Small-anthered bittercress (*Cardamine micranthera*)  
 Smooth coneflower (*Echinacea laevigata*)  
 Spreading avens (*Geum radiatum*)  
 Swamp pink (*Helonias bullata*)  
 Virginia spiraea (*Spiraea virginiana*)  
 White irisette (*Sisyrinchium dichotomum*)

#### North Dakota--10 species

##### Animals--9 species

Crane, whooping (*Grus americana*)  
 Curlew, Eskimo (*Numenius borealis*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Ferret, black-footed (*Mustela nigripes*)  
 Plover, piping (*Charadrius melodus*)  
 Sturgeon, pallid (*Scaphirhynchus albus*)  
 Tern, least (*Sterna antillarum*)  
 Wolf, gray (*Canis lupus*)

##### Plants--1 species

Western prairie fringed orchid (*Platanthera praeclara*)

#### Ohio--18 species

##### Animals--12 species

Bat, Indiana (*Myotis sodalis*)  
 Butterfly, Karner blue (*Lycaeides melissa samuelis*)  
 Clubshell (*Pleurobema clava*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Fanshell (*Cyprogenia stegaria*)  
 Madtom, Scioto (*Noturus trautmani*)  
 Pearlymussel, purple cat's paw (*Epioblasma obliquata obliquata*)  
 Pearlymussel, white cat's paw (*Epioblasma obliquata perobliqua* (=sulcata delicata))  
 Plover, piping (*Charadrius melodus*)  
 Riffleshell, northern (*Epioblasma torulosa rangiana*)  
 Warbler, Kirtland's (*Dendroica kirtlandii*)

##### Plants--6 species

Eastern prairie fringed orchid (*Platanthera leucophaea*)  
 Lakeside daisy (*Hymenoxys herbacea*)  
 Northern wild monkshood (*Aconitum noveboracense*)  
 Running buffalo clover (*Trifolium stoloniferum*)  
 Small whorled pogonia (*Isotria medeoloides*)  
 Virginia spiraea (*Spiraea virginiana*)

#### Oklahoma--17 species

##### Animals--16 species

Bat, Indiana (*Myotis sodalis*)  
 Ozark big-eared (*Plecotus townsendii ingens*)  
 Bat, gray (*Myotis grisescens*)  
 Beetle, American burying (=giant carrion) (*Nicrophorus americanus*)  
 Cavefish, Ozark (*Amblyopsis rosae*)  
 Crane, whooping (*Grus americana*)  
 Curlew, Eskimo (*Numenius borealis*)  
 Darter, leopard (*Percina pantherina*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Madtom, Neosho (*Noturus placidus*)  
 Plover, piping (*Charadrius melodus*)  
 Rock-pocketbook, Ouachita (=Wheeler's pearly mussel) (*Arkansia wheeleri*)  
 Tern, least (*Sterna antillarum*)  
 Vireo, black-capped (*Vireo atricapillus*)  
 Woodpecker, red-cockaded (*Picoides borealis*)

#### Plants--1 species

Western prairie fringed orchid (*Platanthera praeclara*)

#### Oregon--28 species

##### Animals--20 species

Butterfly, Oregon silverspot (*Speyeria zerene hippolyta*)  
 Chub, Borax Lake (*Gila boraxobius*)  
 Chub, Hutton tui (*Gila bicolor ssp.*)  
 Chub, Oregon (*Oregonichthys (=Hybopsis) crameri*)  
 Dace, Fosskett speckled (*Rhinichthys osculus ssp.*)  
 Deer, Columbian white-tailed (*Odocoileus virginianus leucurus*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Goose, Aleutian Canada (*Branta canadensis leucopareia*)  
 Murrelet, marbled (*Brachyramphus marmoratus marmoratus*)  
 Owl, northern spotted (*Strix occidentalis caurina*)  
 Pelican, brown (*Pelecanus occidentalis*)  
 Plover, western snowy (*Charadrius alexandrinus nivosus*)  
 Sucker, Lost River (*Deltistes luxatus*)  
 Sucker, Warner (*Catostomus warnerensis*)  
 Sucker, shortnose (*Chasmistes brevirostris*)  
 Trout, Lahontan cutthroat (*Oncorhynchus (=Salmo) clarki henshawi*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, olive (=Pacific) ridley sea (*Lepidochelys olivacea*)

##### Plants--8 species

Applegate's milk-vetch (*Astragalus applegatei*)  
 Bradshaw's desert-parsley (=lomatium) (*Lomatium bradshawii*)  
 MacFarlane's four-o'clock (*Mirabilis macfarlanei*)  
 Malheur wire-lettuce (*Stephanomeria malheurensis*)  
 Marsh sandwort (*Arenaria paludicola*)  
 Nelson's checker-mallow (*Sidalcea nelsoniana*)  
 Water howellia (*Howellia aquatilis*)  
 Western lily (*Lilium occidentale*)

#### Pennsylvania--10 species

##### Animals--7 species

Bat, Indiana (*Myotis sodalis*)  
 Clamshell (*Pleurobema clava*)  
 Eagle, bald (*Haliaeetus leucocephalus*)

Falcon, American peregrine (*Falco peregrinus anatum*)  
Horned lark, dwarf wedge (*Alasmidonta heterodon*)  
Plover, piping (*Charadrius melodus*)  
Riffleshell, northern (*Epioblasma torulosa rangiana*)

Plants--3 species

Northeastern (=Barbed bristle) bulrush (*Scirpus ancistrochaetus*)  
Small whorled pogonia (*Isotria medeoloides*)  
Virginia spiraea (*Spiraea virginiana*)

Rhode Island--12 species

Animals--10 species

Beetle, American burying (=giant carrion) (*Nicrophorus americanus*)  
Beetle, northeastern beach tiger (*Cicindela dorsalis dorsalis*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Plover, piping (*Charadrius melodus*)  
Tern, roseate (*Sterna dougallii dougallii*)  
Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
Turtle, hawksbill sea (*Eretmochelys imbricata*)  
Turtle, leatherback sea (*Dermochelys coriacea*)  
Turtle, loggerhead sea (*Caretta caretta*)

Plants--2 species

Sandplain gerardia (*Agalinis acuta*)  
Small whorled pogonia (*Isotria medeoloides*)

South Carolina--34 species

Animals--15 species

Bat, Indiana (*Myotis sodalis*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Heelsplitter, Carolina (*Lasmigona decorata*)  
Manatee, West Indian (=Florida) (*Trichechus manatus*)  
Plover, piping (*Charadrius melodus*)  
Snake, eastern indigo (*Drymarchon corais couperi*)  
Stork, wood (*Mycteria americana*)  
Tern, roseate (*Sterna dougallii dougallii*)  
Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
Turtle, green sea (*Chelonia mydas*)  
Turtle, hawksbill sea (*Eretmochelys imbricata*)  
Turtle, leatherback sea (*Dermochelys coriacea*)  
Turtle, loggerhead sea (*Caretta caretta*)  
Woodpecker, red-cockaded (*Picoides borealis*)

Plants--19 species

American chaffseed (*Schwalbea americana*)  
Black-spored quillwort (*Isoetes melanospora*)  
Bunched arrowhead (*Sagittaria fasciculata*)  
Canby's dropwort (*Oxypolis canbyi*)  
Dwarf-flowered heartleaf (*Hexastylis naniflora*)  
Harperella (*Ptilimnium nodosum* (=fluviatile))  
Little amphianthus (*Amphianthus pusillus*)  
Miccousukee gooseberry (*Ribes echinellum*)  
Michaux's sumac (*Rhus michauxii*)  
Mountain sweet pitcher-plant (*Sarracenia rubra* ssp. *jonesii*)  
Persistent trillium (*Trillium persistens*)

Pondberry (*Lindera melissifolia*)  
 White trillium (*Trillium reliquum*)  
 High-leaved loosestrife (*Lysimachia asperulaefolia*)  
 Schweinitz's sunflower (*Helianthus schweinitzii*)  
 Seabeach amaranth (*Amaranthus pumilus*)  
 Small whorled pogonia (*Isotria medeoloides*)  
 Smooth coneflower (*Echinacea laevigata*)  
 Swamp pink (*Helonias bullata*)

#### South Dakota--10 species

##### Animals--10 species

Beetle, American burying (=giant carrion) (*Nicrophorus americanus*)  
 Crane, whooping (*Grus americana*)  
 Curlew, Eskimo (*Numenius borealis*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Ferret, black-footed (*Mustela nigripes*)  
 Plover, piping (*Charadrius melodus*)  
 Sturgeon, pallid (*Scaphirhynchus albus*)  
 Tern, least (*Sterna antillarum*)  
 Wolf, gray (*Canis lupus*)

##### Plants--0 species

#### Tennessee--79 species

##### Animals--62 species

Acornshell, southern (*Epioblasma othcaloogensis*)  
 Bat, Indiana (*Myotis sodalis*)  
 Bat, gray (*Myotis grisescens*)  
 Chub, slender (*Erimystax (=Hybopsis) cahnii*)  
 Chub, spotfin (=turquoise shiner) (*Cyprinella (=Hybopsis) monacha*)  
 Clubshell, ovate (*Pleurobema perovatum*)  
 Clubshell, southern (*Pleurobema decisum*)  
 Combshell, upland (*Epioblasma metastriata*)  
 Crayfish, Nashville (*Orconectes shoupi*)  
 Dace, blackside (*Phoxinus cumberlandensis*)  
 Darter, amber (*Percina antesella*)  
 Darter, bluemask (=jewel) (*Etheostoma (Doration) sp.*)  
 Darter, boulder (=Elk River) (*Etheostoma wapiti*)  
 Darter, duskytail (*Etheostoma (Catonotus) sp.*)  
 Darter, slackwater (*Etheostoma boschungii*)  
 Darter, snail (*Percina tanasi*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Elktoe, Appalachian (*Alasmodonta raveneliana*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Fanshell (*Cyprogenia stegaria*)  
 Kidneyshell, triangular (*Ptychobranhus greeni*)  
 Lampmussel, Alabama (*Lampsilis virescens*)  
 Logperch, Conasauga (*Percina jenkinsi*)  
 Madtom, Smoky (*Noturus baileyi*)  
 Madtom, pygmy (*Noturus stanauli*)  
 Madtom, yellowfin (*Noturus flavipinnis*)  
 Marstonia (snail), royalobese (*Pyrgulopsis (=Marstonia) ogmoraphe*)  
 Moccasinshell, Alabama (*Medionidus acutissimus*)  
 Moccasinshell, Coosa (*Medionidus parvulus*)  
 Mussel, ring pink (=golf stick pearly) (*Obovaria retusa*)  
 Pearlymussel, Appalachian monkeyface (*Quadrula sparsa*)  
 Pearlymussel, Cumberland bean (*Villosa trabalis*)  
 Pearlymussel, Cumberland monkeyface (*Quadrula intermedia*)  
 Pearlymussel, birdwing (*Conradilla caelata*)  
 Pearlymussel, cracking (*Hemistena lata*)  
 Pearlymussel, dromedary (*Dromus dromas*)

Pearlymussel, green-blossom (*Epioblasma torulosa gubernaculum*)  
 Pearlymussel, little-wing (*Pegias fabula*)  
 Pearlymussel, orange-foot pimple back (*Plethobasus cooperianus*)  
 Pearlymussel, pale lilliput (*Toxolasma cylindrellus*)  
 Pearlymussel, pink mucket (*Lampsilis abrupta*)  
 Pearlymussel, purple cat's paw (*Epioblasma obliquata obliquata*)  
 Pearlymussel, tubercled-blossom (*Epioblasma torulosa torulosa*)  
 Pearlymussel, turgid-blossom (*Epioblasma turgidula*)  
 Pearlymussel, white wartyback (*Plethobasus cicatricosus*)  
 Pearlymussel, yellow-blossom (*Epioblasma florentina florentina*)  
 Pigtoe, Cumberland (=Cumberland pigtoe mussel) (*Pleurobema gibberum*)  
 Pigtoe, fine-rayed (*Fusconaia cuneolus*)  
 Pigtoe, rough (*Pleurobema plenum*)  
 Pigtoe, shiny (*Fusconaia cor* (=edgariana))  
 Pigtoe, southern (*Pleurobema georgianum*)  
 Pocketbook, fine-lined (*Lampsilis altilis*)  
 Riffleshell, tan (*Epioblasma walkeri*)  
 Riversnail, Anthony's (*Athearnia anthonyi*)  
 Shiner, blue (*Cyprinella* (=Notropis) *caerulea*)  
 Snail, painted snake coiled forest (*Anguispira picta*)  
 Spruce-fir moss spider (*Microhexura montivaga*)  
 Squirrel, Carolina northern flying (*Glaucomys sabrinus coloratus*)  
 Sturgeon, pallid (*Scaphirhynchus albus*)  
 Tern, least (*Sterna antillarum*)  
 Wolf, red (*Canis rufus*)  
 Woodpecker, red-cockaded (*Picoides borealis*)

#### Plants--17 species

Blue Ridge goldenrod (*Solidago spithamea*)  
 Cumberland rosemary (*Conradina verticillata*)  
 Cumberland sandwort (*Arenaria cumberlandensis*)  
 Green pitcher-plant (*Sarracenia oreophila*)  
 Large-flowered skullcap (*Scutellaria montana*)  
 Leafy prairie-clover (*Dalea* (=Petalostemum) *foliosa*)  
 Price's potato-bean (*Apios priceana*)  
 Pyne's (=Guthrie's) ground-plum (*Astragalus bibullatus*)  
 Roan Mountain bluet (*Hedyotis purpurea* var. *montana*)  
 Rock cress (*Arabis perstellata*)  
 Rock gnome lichen (*Gymnoderma lineare*)  
 Ruth's golden aster (*Pityopsis* (=Heterotheca) *chrysopsis*) *ruthii*)  
 Small whorled pogonia (*Isotria medeoloides*)  
 Spreading avens (*Geum radiatum*)  
 Tennessee purple coneflower (*Echinacea tennesseensis*)  
 Tennessee yellow-eyed grass (*Xyris tennesseensis*)  
 Virginia spiraea (*Spiraea virginiana*)

#### Texas--70 species

#### Animals--43 species

Bat, Mexican long-nosed (*Leptonycteris nivalis*)  
 Bear, Louisiana black (*Ursus americanus luteolus*)  
 Beetle, Coffin Cave mold (*Batrissodes texanus*)  
 Beetle, Kretschmarr Cave mold (*Texamaurops reddelli*)  
 Beetle, Tooth Cave ground (*Rhadine persephone*)  
 Crane, whooping (*Grus americana*)  
 Curlew, Eskimo (*Numenius borealis*)  
 Darter, fountain (*Etheostoma fonticola*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Falcon, northern aplomado (*Falco femoralis septentrionalis*)  
 Flycatcher, Southwestern willow (*Empidonax traillii extimus*)  
 Gambusia, Big Bend (*Gambusia gaigei*)  
 Gambusia, Clear Creek (*Gambusia heterochir*)  
 Gambusia, Pecos (*Gambusia nobilis*)

Gambusia, San Marcos (*Gambusia georgei*)  
 Harvestman, Bee Creek Cave (*Texella reddelli*)  
 Harvestman, Bone Cave (*Texella reyesi*)  
 Jaguarundi (*Felis yagouaroundi cacomitli*)  
 Manatee, West Indian (=Florida) (*Trichechus manatus*)  
 Minnow, Rio Grande silvery (*Hybognathus amarus*)  
 Ocelot (*Felis pardalis*)  
 Owl, Mexican spotted (*Strix occidentalis lucida*)  
 Pelican, brown (*Pelecanus occidentalis*)  
 Plover, piping (*Charadrius melodus*)  
 Prairie-chicken, Attwater's greater (*Tympanuchus cupido attwateri*)  
 Pseudoscorpion, Tooth Cave (*Microcreagris texana*)  
 Pupfish, Comanche Springs (*Cyprinodon elegans*)  
 Pupfish, Leon Springs (*Cyprinodon bovinus*)  
 Salamander, San Marcos (*Eurycea nana*)  
 Salamander, Texas blind (*Typhlomolge rathbuni*)  
 Snake, Concho water (*Nerodia paucimaculata*)  
 Spider, Tooth Cave (*Leptoneta myopica*)  
 Tern, least (*Sterna antillarum*)  
 Toad, Houston (*Bufo houstonensis*)  
 Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempii*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, hawksbill sea (*Eretmochelys imbricata*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, loggerhead sea (*Caretta caretta*)  
 Vireo, black-capped (*Vireo atricapillus*)  
 Warbler, golden-cheeked (*Dendroica chrysoparia*)  
 Woodpecker, red-cockaded (*Picoides borealis*)

#### Plants--27 species

Ashy dogweed (*Thymophylla tephroleuca*)  
 Black lace cactus (*Echinocereus reichenbachii* (=melanocentrus) var. al  
 rtii)  
 Bunched cory cactus (*Coryphantha ramillosa*)  
 Chisos Mountain hedgehog cactus (*Echinocereus chisoensis* var. chisoens  
 is)  
 Davis' green pitaya (*Echinocereus viridiflorus* var. davisii)  
 Hinckley's oak (*Quercus hinckleyi*)  
 Johnston's frankenia (*Frankenia johnstonii*)  
 Large-fruited sand-verbena (*Abronia macrocarpa*)  
 Little Aguja pondweed (*Potamogeton clystocarpus*)  
 Lloyd's Mariposa cactus (*Echinomastus* (=Sclerocactus) mariposensis)  
 Lloyd's hedgehog cactus (*Echinocereus lloydii*)  
 Navasota ladies'-tresses (*Spiranthes parksii*)  
 Nellie cory cactus (*Coryphantha* (=Escobaria) minima)  
 Slender rush-pea (*Hoffmannseggia tenella*)  
 Sneed pincushion cactus (*Coryphantha sneedii* var. sneedii)  
 South Texas ambrosia (*Ambrosia cheiranthifolia*)  
 Star cactus (*Astrophytum asterias*)  
 Terlingua Creek cats-eye (*Cryptantha crassipes*)  
 Texas ayenia (*Ayenia limitaris*)  
 Texas poppy-mallow (*Callirhoe scabriuscula*)  
 Texas prairie dawn-flower (=Texas bitterweed) (*Hymenoxys texana*)  
 Texas snowbells (*Styrax texana*)  
 Texas trailing phlox (*Phlox nivalis* ssp. texensis)  
 Texas wild-rice (*Zizania texana*)  
 Tobusch fishhook cactus (*Ancistrocactus tobuschii*)  
 Walker's manioc (*Manihot walkerae*)  
 White bladderpod (*Lesquerella pallida*)

#### Utah--38 species

#### Animals--18 species

Ambersnail, Kanab (*Oxyloma haydeni kanabensis*)

Chub, Virgin River (*Gila robusta semidnuda*)  
 b, bonytail (*Gila elegans*)  
 b, humpback (*Gila cypha*)  
 Crane, whooping (*Grus americana*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Ferret, black-footed (*Mustela nigripes*)  
 Flycatcher, Southwestern willow (*Empidonax traillii extimus*)  
 Owl, Mexican spotted (*Strix occidentalis lucida*)  
 Prairie dog, Utah (*Cynomys parvidens*)  
 Snail, Utah valvata (*Valvata utahensis*)  
 Squawfish, Colorado (*Ptychocheilus lucius*)  
 Sucker, June (*Chasmistes liorus*)  
 Sucker, razorback (*Xyrauchen texanus*)  
 Tortoise, desert (*Gopherus agassizii*)  
 Trout, Lahontan cutthroat (*Oncorhynchus (=Salmo) clarki henshawi*)  
 Woundfin (*Plagopterus argentissimus*)

#### Plants--20 species

Autumn buttercup (*Ranunculus acriformis* var. *aestivalis*)  
 Barneby reed-mustard (*Schoenocrambe barnebyi*)  
 Barneby ridge-cress (=peppercress) (*Lepidium barnebyanum*)  
 Clay phacelia (*Phacelia argillacea*)  
 Clay reed-mustard (*Schoenocrambe argillacea*)  
 Dwarf bear-poppy (*Arctomecon humilis*)  
 Heliotrope milk-vetch (*Astragalus montii*)  
 Jones cycladenia (*Cycladenia humilis* var. *jonesii*)  
 Kodachrome bladderpod (*Lesquerella tumulosa*)  
 Last Chance townsendia (*Townsendia aprica*)  
 Maguire daisy (*Erigeron maguirei* var. *maguirei*)  
 Maguire primrose (*Primula maguirei*)  
 Navajo sedge (*Carex specuicola*)  
 Rafael cactus (*Pediocactus despainii*)  
 Scrubby reed-mustard (=toad-flax cress) (*Schoenocrambe suffrutescens*)  
 Siler pincushion cactus (*Pediocactus sileri*)  
 Uinta Basin hookless cactus (*Sclerocactus glaucus*)  
 Ute ladies'-tresses (*Spiranthes diluvialis*)  
 Welsh's milkweed (*Asclepias welshii*)  
 Wright fishhook cactus (*Sclerocactus wrightiae*)

#### Vermont--7 species

##### Animals--5 species

Bat, Indiana (*Myotis sodalis*)  
 Beetle, Puritan tiger (*Cicindela puritana*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Mussel, dwarf wedge (*Alasmidonta heterodon*)

##### Plants--2 species

Jesup's milk-vetch (*Astragalus robbinsii* var. *jesupi*)  
 Northeastern (=Barbed bristle) bulrush (*Scirpus ancistrochaetus*)

#### Virginia--48 species

##### Animals--38 species

Bat, Indiana (*Myotis sodalis*)  
 Bat, Virginia big-eared (*Plecotus townsendii virginianus*)  
 Bat, gray (*Myotis grisescens*)  
 Beetle, northeastern beach tiger (*Cicindela dorsalis dorsalis*)

Chub, slender (*Erimystax (=Hybopsis) cahni*)  
 Spotfin (=turquoise shiner) (*Cyprinella (=Hybopsis) mcrae*)  
 Darter, duskytail (*Etheostoma (Catonotus) sp.*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Fanshell (*Cyprogenia stegaria*)  
 Isopod, Lee County cave (*Lirceus usdagalun*)  
 Isopod, Madison Cave (*Antrilana lira*)  
 Logperch, Roanoke (*Percina rex*)  
 Madtom, yellowfin (*Noturus flavipinnis*)  
 Mussel, dwarf wedge (*Alasmidonta heterodon*)  
 Pearlymussel, Appalachian monkeyface (*Quadrula sparsa*)  
 Pearlymussel, Cumberland monkeyface (*Quadrula intermedia*)  
 Pearlymussel, birdwing (*Conradilla caelata*)  
 Pearlymussel, cracking (*Hemistena lata*)  
 Pearlymussel, dromedary (*Dromus dromas*)  
 Pearlymussel, green-blossom (*Epioblasma torulosa gubernaculum*)  
 Pearlymussel, little-wing (*Pegias fabula*)  
 Pigtoe, fine-rayed (*Fusconaia cuneolus*)  
 Pigtoe, shiny (*Fusconaia cor (=edgariana)*)  
 Plover, piping (*Charadrius melodus*)  
 Riffleshell, tan (*Epioblasma walkeri*)  
 Salamander, Shenandoah (*Plethodon shenandoah*)  
 Shrew, Dismal Swamp southeastern (*Sorex longirostris fisheri*)  
 Snail, Virginia fringed mountain (*Polygyriscus virginianus*)  
 Spiny mussel, James River (=Virginia) (*Pleurobema collina*)  
 Squirrel, Delmarva Peninsula fox (*Sciurus niger cinereus*)  
 Squirrel, Virginia northern flying (*Glaucomys sabrinus fuscus*)  
 Turtle, Kemp's (=Atlantic) ridley sea (*Lepidochelys kempi*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, hawksbill sea (*Eretmochelys imbricata*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, loggerhead sea (*Caretta caretta*)  
 Pecker, red-cockaded (*Picoides borealis*)

#### Plants--10 species

Eastern prairie fringed orchid (*Platanthera leucophaea*)  
 Northeastern (=Barbed bristle) bulrush (*Scirpus ancistrochaetus*)  
 Peter's Mountain mallow (*Iliamna corei*)  
 Sensitive joint-vetch (*Aeschynomene virginica*)  
 Shale barren rock-cress (*Arabis serotina*)  
 Small whorled pogonia (*Isotria medeoloides*)  
 Smooth coneflower (*Echinacea laevigata*)  
 Swamp pink (*Helonias bullata*)  
 Virginia round-leaf birch (*Betula uber*)  
 Virginia spiraea (*Spiraea virginiana*)

#### Washington--18 species

#### Animals--15 species

Bear, grizzly (*Ursus arctos*)  
 Butterfly, Oregon silverspot (*Speyeria zerene hippolyta*)  
 Caribou, woodland (*Rangifer tarandus caribou*)  
 Deer, Columbian white-tailed (*Odocoileus virginianus leucurus*)  
 Eagle, bald (*Haliaeetus leucocephalus*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)  
 Goose, Aleutian Canada (*Branta canadensis leucopareia*)  
 Murrelet, marbled (*Brachyramphus marmoratus marmoratus*)  
 Owl, northern spotted (*Strix occidentalis caurina*)  
 Pelican, brown (*Pelecanus occidentalis*)  
 Plover, western snowy (*Charadrius alexandrinus nivosus*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, olive (=Pacific) ridley sea (*Lepidochelys olivacea*)

Wolf, gray (*Canis lupus*)

Plants--3 species

Marsh sandwort (*Arenaria paludicola*)  
Nelson's checker-mallow (*Sidalcea nelsoniana*)  
Water howellia (*Howellia aquatilis*)

West Virginia--18 species

Animals--13 species

Bat, Indiana (*Myotis sodalis*)  
Bat, Virginia big-eared (*Plecotus townsendii virginianus*)  
Clubshell (*Pleurobema clava*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Fanshell (*Cyprogenia stegaria*)  
Pearlymussel, pink mucket (*Lampsilis abrupta*)  
Pearlymussel, tubercled-blossom (*Epioblasma torulosa torulosa*)  
Riffleshell, northern (*Epioblasma torulosa rangiana*)  
Salamander, Cheat Mountain (*Plethodon nettingi*)  
Snail, flat-spined three-toothed (*Triodopsis platysayoides*)  
Spinymussel, James River (=Virginia) (*Pleurobema collina*)  
Squirrel, Virginia northern flying (*Glaucomys sabrinus fuscus*)

Plants--5 species

Harperella (*Ptilimnium nodosum* (=fluviatile))  
Northeastern (=Barbed bristle) bulrush (*Scirpus ancistrochaetus*)  
Running buffalo clover (*Trifolium stoloniferum*)  
Shale barren rock-cress (*Arabis serotina*)  
Virginia spiraea (*Spiraea virginiana*)

Wisconsin--16 species

Animals--10 species

Bat, Indiana (*Myotis sodalis*)  
Butterfly, Karner blue (*Lycaeides melissa samuelis*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Hine's emerald dragonfly (*Somatochlora hineana*)  
Mussel, winged mapleleaf (*Quadrula fragosa*)  
Pearlymussel, Higgins' eye (*Lampsilis higginsii*)  
Plover, piping (*Charadrius melodus*)  
Warbler, Kirtland's (*Dendroica kirtlandii*)  
Wolf, gray (*Canis lupus*)

Plants--6 species

Dwarf lake iris (*Iris lacustris*)  
Eastern prairie fringed orchid (*Platanthera leucophaea*)  
Fassett's locoweed (*Oxytropis campestris* var. *chartacea*)  
Northern wild monkshood (*Aconitum noveboracense*)  
Pitcher's thistle (*Cirsium pitcheri*)  
Prairie bush-clover (*Lespedeza leptostachya*)

Wyoming--11 species

Animals--10 species

Bear, grizzly (*Ursus arctos*)

Crane, whooping (*Grus americana*)  
Kendall Warm Springs (*Rhinichthys osculus thermalis*)  
Eagle, bald (*Haliaeetus leucocephalus*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Ferret, black-footed (*Mustela nigripes*)  
Squawfish, Colorado (*Ptychocheilus lucius*)  
Sucker, razorback (*Xyrauchen texanus*)  
Toad, Wyoming (*Bufo hemiophrys baxteri*)  
Wolf, gray (*Canis lupus*)

Plants--1 species

Ute ladies'-tresses (*Spiranthes diluvialis*)

American Samoa--5 species

Animals--5 species

Turtle, green sea (*Chelonia mydas*)  
Turtle, hawksbill sea (*Eretmochelys imbricata*)  
Turtle, leatherback sea (*Dermochelys coriacea*)  
Turtle, loggerhead sea (*Caretta caretta*)  
Turtle, olive (=Pacific) ridley sea (*Lepidochelys olivacea*)

Plants--0 species

No plant species

Guam--16 species

Animals--15 species

Bird, Mariana fruit (*Pteropus mariannus mariannus*)  
Bat, little Mariana fruit (*Pteropus tokudae*)  
Broadbill, Guam (*Myiagra freycineti*)  
Crow, Mariana (*Corvus kubaryi*)  
Kingfisher, Guam Micronesia (*Halcyon cinnamomina cinnamomina*)  
Mallard, Mariana (*Anas oustaleti*)  
Moorhen (=gallinule), Mariana common (*Gallinula chloropus guamensis*)  
Rail, Guam (*Rallus owstoni*)  
Swiftlet, Mariana gray (=vanikoro) (*Aerodramus vanikorensis bartschi*)  
Turtle, green sea (*Chelonia mydas*)  
Turtle, hawksbill sea (*Eretmochelys imbricata*)  
Turtle, leatherback sea (*Dermochelys coriacea*)  
Turtle, loggerhead sea (*Caretta caretta*)  
Turtle, olive (=Pacific) ridley sea (*Lepidochelys olivacea*)  
White-eye, bridled (*Zosterops conspicillatus conspicillatus*)

Plants--1 species

Hayun lagu (Guam), Tronkon guafi (Rota) (*Serianthes nelsonii*)

Commonwealth of the Northern Marianas Islands--13 species

Plants--1 species

Animals--12 species

Crow, Mariana (*Corvus kubaryi*)  
Mallard, Mariana (*Anas oustaleti*)  
Megapode, Micronesian (=La Perouse's) (*Megapodius laperouse*)  
Monarch, Tinian (*Monarcha takatsukasae*)  
Moorhen (=gallinule), Mariana common (*Gallinula chloropus guamensis*)  
Swiftlet, Mariana gray (=vanikoro) (*Aerodramus vanikorensis bartschi*)

Turtle, green sea (*Chelonia mydas*)  
Turtle, hawksbill sea (*Eretmochelys imbricata*)  
Turtle, leatherback sea (*Dermochelys coriacea*)  
Turtle, loggerhead sea (*Caretta caretta*)  
Turtle, olive (=Pacific) ridley sea (*Lepidochelys olivacea*)  
Warbler, nightingale reed (*Acrocephalus luscini*)

Plants--1 species

Hayun lagu (Guam), Tronkon guafi (Rota) (*Serianthes nelsonii*)

Puerto Rico--69 species

Animals--23 species

Anole, Culebra Island giant (*Anolis roosevelti*)  
Blackbird, yellow-shouldered (*Agelaius xanthomus*)  
Boa, Mona (*Epicrates monensis monensis*)  
Boa, Puerto Rican (*Epicrates inornatus*)  
Boa, Virgin Islands tree (*Epicrates monensis granti*)  
Coqui, golden (*Eleutherodactylus jasper*)  
Falcon, American peregrine (*Falco peregrinus anatum*)  
Gecko, Monito (*Sphaerodactylus micropithecus*)  
Hawk, Puerto Rican broad-winged (*Buteo platypterus brunescens*)  
Hawk, Puerto Rican sharp-shinned (*Acipiter striatus venator*)  
Iguana, Mona ground (*Cyclura stejnegeri*)  
Manatee, West Indian (=Florida) (*Trichechus manatus*)  
Parrot, Puerto Rican (*Amazona vittata*)  
Pelican, brown (*Pelecanus occidentalis*)  
Pigeon, Puerto Rican plain (*Columba inornata wetmorei*)  
Plover, piping (*Charadrius melodus*)  
Puerto Rican nightjar (=whip-poor-will) (*Caprimulgus noctitherus*)  
Stern, roseate (*Sterna dougallii dougallii*)  
Squirrel, Puerto Rican crested (*Peltophryne lemur*)  
Turtle, green sea (*Chelonia mydas*)  
Turtle, hawksbill sea (*Eretmochelys imbricata*)  
Turtle, leatherback sea (*Dermochelys coriacea*)  
Turtle, loggerhead sea (*Caretta caretta*)

Plants--46 species

*Adiantum vivesii* (Plant, no common name)  
*Aristida chaseae* (Plant, no common name)  
*Auerodendron pauciflorum* (Plant, no common name)  
*Calyptanthus thomasi* (Plant, no common name)  
*Chamaecrista glandulosa* var. *mirabilis* (=Cassia *mirabilis*) (Plant, no common name)  
*Cranichis ricartii* (Plant, no common name)  
*Daphnopsis hellerana* (Plant, no common name)  
*Elaphoglossum serpens* (Plant, no common name)  
*Eugenia woodburyana* (Plant, no common name)  
*Gesneria pauciflora* (Plant, no common name)  
*Ilex sintenisii* (Plant, no common name)  
*Lepanthes eltoroensis* (Plant, no common name)  
*Leptocereus grantianus* (Plant, no common name)  
*Lyonia truncata* var. *proctorii* (Plant, no common name)  
*Mitracarpus maxwelliae* (Plant, no common name)  
*Mitracarpus polycladus* (Plant, no common name)  
*Myrcia paganii* (Plant, no common name)  
*Polystichum calderonense* (Plant, no common name)  
*Schoepfia arenaria* (Plant, no common name)  
*Tectaria estremerana* (Plant, no common name)  
*Ternstroemia subsessilis* (Plant, no common name)  
*Thelypteris inabonensis* (Plant, no common name)  
*Thelypteris verecunda* (Plant, no common name)  
*Thelypteris yaucoensis* (Plant, no common name)  
*Vernonia proctorii* (Plant, no common name)

Bariaco (=guayabacón) (*Trichilia triacantha*;  
 beautiful goetzea or matabuey (*Goetzea elegans*)  
 rosa (=p,ndula cimarrona) (*Callicarpa ampla*)  
 Chupacallos (=Chupagallo) (*Pleodendron macranthum*)  
 Cook's holly (*Ilex cookii*)  
 Cebana negra (*Stahlia monosperma*)  
 Elfin tree fern (*Cyathea dryopteroides*)  
 Erubia (*Solanum drymophilum*)  
 Higo chumbo (*Harrisia portoricensis*)  
 Higuero de Sierra (*Crescentia portoricensis*)  
 Palma de manaca or manac palm (*Calyptronoma rivalis*)  
 Palo colorado (*Ternstroemia luquillensis*)  
 Palo de Ramón (*Banara vanderbiltii*)  
 Palo de jazmín (*Styrax portoricensis*)  
 Palo de nigua (=cap juguilla) (*Cornutia obovata*)  
 Palo de rosa (*Ottoschulzia rhodoxylon*)  
 Pelos del diablo (*Aristida portoricensis*)  
 St. Thomas prickly-ash (*Zanthoxylum thomasianum*)  
 Uvillo (*Eugenia haematocarpa*)  
 Vahl's boxwood (*Buxus vahlii*)  
 Wheeler's peperomia (*Peperomia wheeleri*)

#### Virgin Islands--12 species

##### Animals--9 species

Falcon, American peregrine (*Falco peregrinus anatum*)  
 Lizard, St. Croix ground (*Ameiva polops*)  
 Manatee, West Indian (=Florida) (*Trichechus manatus*)  
 Pelican, brown (*Pelecanus occidentalis*)  
 Tern, roseate (*Sterna dougallii dougallii*)  
 Turtle, green sea (*Chelonia mydas*)  
 Turtle, hawksbill sea (*Eretmochelys imbricata*)  
 Turtle, leatherback sea (*Dermochelys coriacea*)  
 Turtle, loggerhead sea (*Caretta caretta*)

##### Plants--3 species

Calyptranthes thomasi (Plant, no common name)  
 St. Thomas prickly-ash (*Zanthoxylum thomasianum*)  
 Vahl's boxwood (*Buxus vahlii*)

#### District of Columbia--2 species

##### Animals--2 species

Amphipod, Hay's Spring (*Stygobromus hayi*)  
 Falcon, American peregrine (*Falco peregrinus anatum*)

##### Plants--0 species

No plant species

GE 1989a



*GE NUCLEAR ENERGY*

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# ENVIRONMENTAL REPORT

**NUCLEAR FUEL & COMPONENTS MANUFACTURING**

**WILMINGTON, NORTH CAROLINA**

NEDO-3166

CLASS I

MAY 1989

8906220109 890523  
PDR ADOCK 07001113  
B PDC

GE 19896

GE NUCLEAR ENERGY  
WILMINGTON, NORTH CAROLINA

# LICENSE RENEWAL APPLICATION

MAY 22, 1989

USNRC MATERIALS LICENSE SNM-1097  
DOCKET 70-1113



8906220106 890523  
AND ADDED 07001113

GE 1989c

GE NUCLEAR ENERGY  
NUCLEAR FUEL & COMPONENTS MANUFACTURING  
WILMINGTON, NORTH CAROLINA

# DECOMMISSIONING AND CLOSURE PLAN

MAY 1, 1989

NRC LICENSE SNM-1097  
DOCKET 70-1113

8906220111 890523  
PDR ADOCK 07001113  
B FDC

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**Environmental Impact Appraisal**  
for renewal of  
**Special Nuclear Material**  
**License No. SNM-1097**

Docket No. 70-1113

General Electric Company  
Wilmington Manufacturing Department

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**U.S. Nuclear Regulatory  
Commission**

Office of Nuclear Material Safety and Safeguards

June 1984



HF DOE 1990e

DOE/RL-89-15

# Hanford Site Development Plan



Richland Operations Office  
January 1990

**Hanford**  
A National Asset

# Hanford Site Development Plan

Approved:

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**John D. Wagoner, Manager**  
U.S. Department of Energy,  
Richland Field Office

Prepared for the U.S. Department  
of Energy, Richland Field Office  
by Westinghouse Hanford Company,  
Site Planning

Principal Author:  
**H.B. Hathaway**  
Westinghouse Hanford Company

Contributing Authors:  
**K.S. Daly**  
**C.A. Rinne**  
**S.W. Seiler**  
Westinghouse Hanford Company

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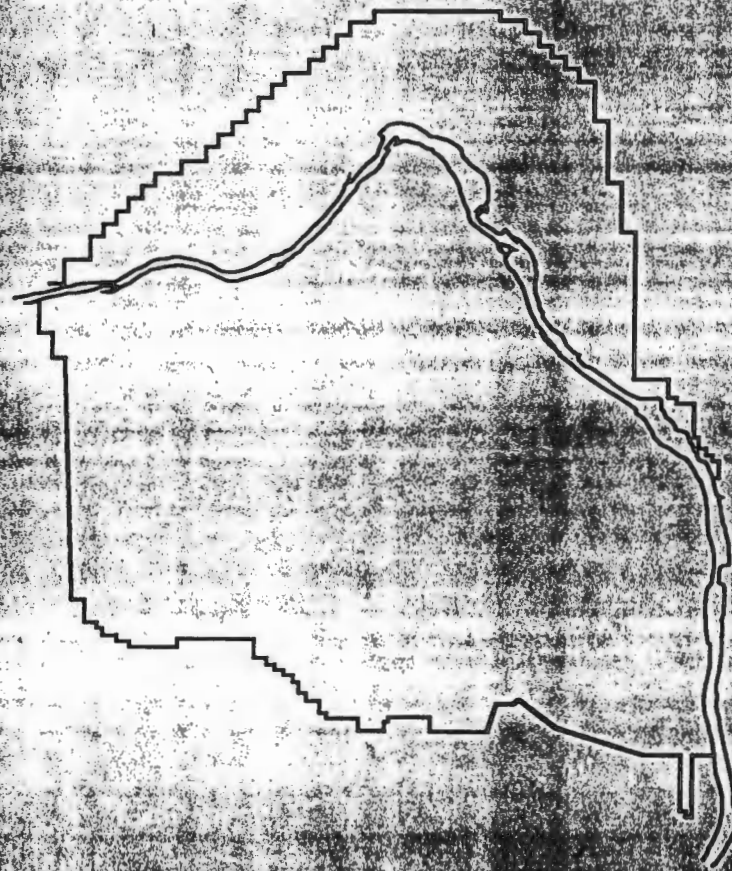


United States  
Department of Energy  
P.O. Box 550  
Richland, Washington 99352

HF DOE 1992b

# THE FUTURE FOR HANFORD: USES AND CLEANUP

*The Final Report of the  
Hanford Future Site Uses Working Group*



December 1992

# Hanford Future Site Uses Working Group

December 22, 1992

Ms. Dana Rasmussen, Administrator  
U.S. Environmental Protection Agency  
Region 10

Mr. John Wagoner, Manager  
U.S. Department of Energy  
Richland Field Office

Mr. Fred Olson, Acting Director  
Washington Department of Ecology

Dear Ms. Rasmussen, Mr. Wagoner, and Mr. Olson:

On behalf of the Hanford Future Site Uses Working Group, it is my pleasure to present you with the Working Group's final report, "The Future For Hanford: Uses and Cleanup."

As charged, the Working Group has worked diligently and productively through the nine months of its existence to learn about the Hanford Site. On the basis of an understanding of its past and present, they have developed an array of options for ways that different parts of the site could be used in the future. They have also thought through the implications of these future uses for cleanup. The report identifies the cleanup scenarios necessary to enable these future uses to occur and provides major recommendations regarding priorities for cleanup and ways to focus the cleanup most efficiently.

The Working Group was convened in April 1992 by the governmental entities (federal, tribal, state, and local) with important interests in Hanford and its cleanup. The Working Group was comprised of these entities and representatives from constituencies (labor, environmental, agricultural, economic development, cities, and public interest groups) vitally concerned about possible future uses of Hanford and the conduct of cleanup.

The Working Group provided a range of future land use options rather than selecting a single use for specific areas of the site. As such, the Group's efforts represent a major milestone in setting the stage for a more focused debate over Hanford's future. This future can only be assured by a successful cleanup. The report stresses the crucial importance of sharpening the focus on cleanup and describes critical ways this can best be accomplished.

**Chairman**  
Dr. Marshall E. Drummond, President  
Eastern Washington University

**U.S. Department of Energy**  
Leo Little, Assistant Manager,  
Environmental Management  
Ron Izett, Deputy Assistant Manager  
Environmental Management  
Sue Weisberg, Environmental Restoration Division

**U.S. Environmental Protection Agency**  
Randy Smith, Director, Hazardous Waste Division  
Paul Day, Hanford Project Manager

**U.S. Department of Interior**  
Dave Goetz, Project Leader  
U.S. Fish and Wildlife Service  
Bob Karoth, National Park Service

**Confederated Tribes of the  
Umatilla Indian Reservation**  
Bill Burke, Treasurer, Board of Trustees  
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**Yakima Indian Nation**  
Russell Jim, Manager, Environmental  
Restoration/Waste Management Program  
Randall Tule, Tribal Member  
Bob Cook, Technical Analyst

**Nez Perce Tribe**  
J. Herman Reshen, Chairman  
Nez Perce General Council

**State of Washington**  
Jeff Brechel, Office of the Governor  
Max Power, Department of Ecology

**State of Oregon**  
Mike Grainey, Assistant to Director  
Department of Energy  
Ralph Pett, Department of Water Resources

**Benton County**  
Sandi Strum, Commissioner  
Phil Mees, Planning Department

**Franklin County**  
Harold Mathews, Commissioner

**Grant County**  
Helen Fancher, Commissioner  
Dave Yorgeson, Agriculturist

**Economic Development/Business**  
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**Agriculture**  
Bryan Alford, Alford Farms  
Clayton Alford, Alford Farms  
Carol Mercer, CMM Management Services  
Mike Hogue, Hogue Ranches  
Dick Olsen, Olsen Ranches

**Hanford Interest Groups**  
Lynne Stenbridge, Executive Director  
Hanford Education Action League  
Gerald Pollet, Executive Director  
Heart of America Northwest

**Environmental Groups**  
Rick Lesomont, Lower Columbia Basin  
Audubon Society  
Kathy Criddle, Lower Columbia Basin  
Audubon Society  
Jeb Baldi, Columbia River Conservation League/  
Washington Environmental Council  
Rick Steele, Columbia River Conservation League  
Cindy deBruler, Columbia River United  
Daniel Dencer, Columbia River United

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Jim Worthington, Executive Secretary  
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Ed Hargrow, Pasco City Council

**Unaffiliated**  
Polo Coronado, Dean of Instruction  
Columbia Basin College  
Judy Chase, Co-President, Benton-Franklin  
County League of Women Voters/  
Liaison to City of Kennewick

HF DOE 1993a

DOE/RL 92-27

# Environmental Restoration and Waste Management Fiscal Year 1993 Site-Specific Plan for the Richland Field Office

DRAFT



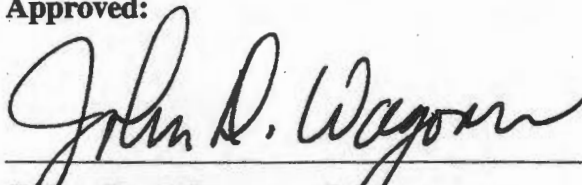
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This Document was prepared for release in October 1992. Department of Energy-Headquarters approval to release the document did not come until March 1993. In the interim, many of the programs underwent significant changes.

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# Hanford Site Development Plan

Approved:



**John D. Wagoner, Manager**

U.S. Department of Energy,  
Richland Operations Office

Prepared for the U.S. Department  
of Energy, Richland Operations Office  
by Westinghouse Hanford Company,  
Site Planning

Principal Author:

**H.B. Hathaway**  
Westinghouse Hanford Company

Contributing Authors:

**K.S. Daly**  
**C.A. Rinne**  
**S.W. Seiler**  
Westinghouse Hanford Company

Date Published

May 1993



United States  
Department of Energy

P.O. Box 550  
Richland, Washington 99352

# Hanford Site Development Plan

Approved:

---

**John D. Wagoner, Manager**  
U.S. Department of Energy,  
Richland Operations Office

Prepared for the U.S. Department of Energy,  
Richland Operations Office  
by ICF Kaiser Hanford Company,  
Site Planning

Principal Author:  
H.B. Hathaway  
ICF Kaiser Hanford Company

Date Published  
January 1995



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P.O. Box 550  
Richland, Washington 99352

HF DOE 1994b

This document was updated and has been provided to the reading room. See citation  
HF DOE 1996a.

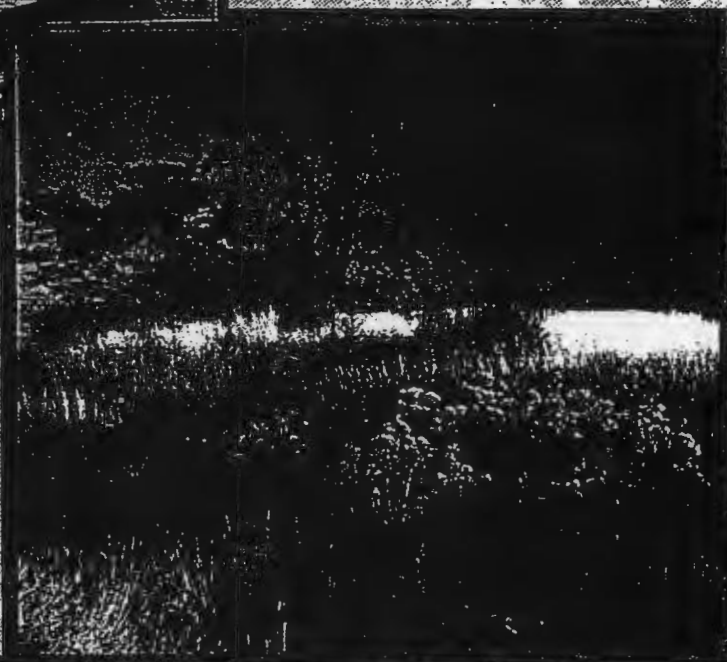
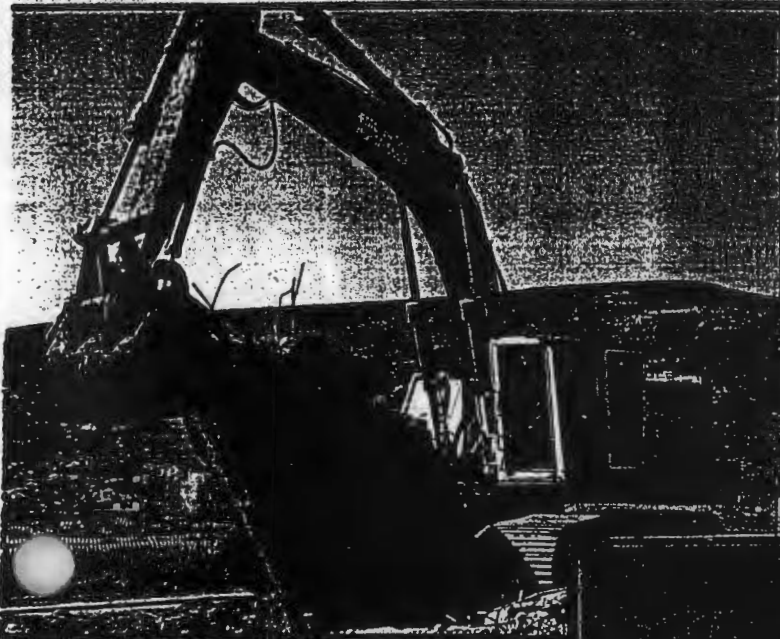
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RL-W94-044

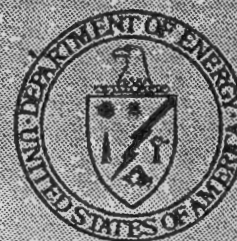
**HF DOE 1995c**

# Hanford Site

E V E L O P M E N T P L A N



Richland Operations Office  
January 1995



HF DUE 1995d

DOE/RL-95-15

# 1995 Report on Hanford Site Land Disposal Restrictions for Mixed Waste

1995 Report on Hanford Site Land  
Disposal Restrictions for Mixed Waste



United States  
Department of Energy  
Richland, Washington



Richland  
Operations  
Office

Approved for Public Release

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9205  
B

HF DOE 1995d

DOE/RL-95-15

UC-630

# **1995 Report on Hanford Site Land Disposal Restrictions for Mixed Waste**

D. G. Black

Date Published  
April 1995



**United States  
Department of Energy**

P.O. Box 550  
Richland, Washington 99352

Approved for Public Release

**HF DOE 1995e:1**

8 PAGES

September 29, 1995

**Estimated Impacts from Storage of 10t of  
Rocky Flats Plutonium at the Hanford Site**

To: Kitty Gandee @ FAX: [REDACTED] TEL: [REDACTED]  
DOE-HQ, Office of Fissile Materials Disposition (MD)

From: John Kovacs, DOE-RL

TEL: (509) [REDACTED]

FAX: [REDACTED]

Attached are the completed Hanford Site estimates of the Impacts of accepting approximately 10 metric tons of Rocky Flats plutonium at Hanford. These are provided for the fissile materials storage and disposition PEIS. The data are increments to the previous Hanford Site data contained in document DOE/RL-93-0100, Revision 1, "Hanford Site Data for the Weapons Complex Reconfiguration Programmatic Environmental Impact Statement", July 1994.

As noted during the Site visit, Hanford has enough space in existing facilities to accommodate the Rocky Flats material without new construction. There are approximately 2000 spaces in the Plutonium Finishing Plant (PFP), with some of these spaces becoming available as DNFSB 94-1 activities consolidate material into fewer containers (currently there are approximately 750 available). An additional 1500 spaces are available in the existing SNM storage vault (never activated) at the Fuels and Materials Examination Facility (FMEF). However, this option was not analyzed because PFP could only provide interim storage. Long term storage (approximately 50 years) would require upgrades to the facility to meet the current safety, security, and occupational exposure requirements of the PEIS.

The estimates for waste generation during construction and some operational data (as noted previously) were developed by Fluor Daniel. We note that a comparative table prepared by Tetra Tech shows differences in estimates for waste generation at INEL, Hanford, and SRS that appear to be much greater than can be explained by the differences in the quantity of material being stored. Data from this table were combined into a smaller, single page table that is included as page 8. I would welcome the opportunity to discuss this and determine what needs to be done to resolve this issue. If you have any questions, please call me. If you are unable to reach me, call Don Sandberg at (509) 376-0030 (or FAX (509) 376-2307).

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Fax #	(509) [REDACTED]	Fax #	(509) [REDACTED]		

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HF MMES 1993a



**TETRA TECH, INC.**

4700 King Street, Suite 500  
Alexandria, VA 22302  
Telephone (703) 931-9301  
FAX (703) 931-9222

July 12, 1993

**TO WHOM IT MAY CONCERN:**

The attached information was obtained from the Waste Management Information System (WMIS). WMIS is a data base that supports the Department of Energy (DOE), Office of Environmental Restoration and Waste Management, Office of Waste Operations. WMIS contains information on wastes produced by DOE's processing, manufacturing, and research activities, as well as information on DOE's treatment, storage, and disposal (T/S/D) capabilities. It is available to users nationwide and used by DOE Headquarters, field offices, and contractors to access information that can be used for strategic planning and reporting to government and private organizations. The WMIS data base currently contains two types of information, waste stream information and T/S/D capabilities. The attached information was obtained from the T/S/D unit capabilities part of the data base.

To request reports or to obtain more information about WMIS, please call or write:

Lise Wachter [REDACTED]  
Waste Management Information System  
Hazardous Waste Remedial Actions Program  
Martin Marietta Energy Systems, Inc.  
Post Office Box 2003, 831TCB, MS 7606  
Oak Ridge, TN 37831-7606

9/11/93

HF NPS 1994a



# Handford Reach of the Columbia River

Columbia River Conservation Study  
and Environmental Impact Statement

FINAL June 1994

Volume I

# AFFECTED ENVIRONMENT

## A. STUDY AREA

The study area is located in southeast Washington and lies within portions of Benton, Grant, Franklin, and Adams counties (Map #1). It extends from one mile below Priest Rapids Dam (river mile 396) downstream approximately 51 miles to the McNary Pool north of Richland, Washington (river mile 345). This segment of the Columbia River is considered the last free-flowing, non-tidal segment of the Columbia in the United States. The river flows east and south through the 353,000-acre Hanford Site, established in 1943 and administered by the Department of Energy (DOE) (Map #9). Total acreage of the study area is approximately 105,000 acres and includes the river itself, islands, Wahluke State Wildlife Recreation Area, Saddle Mountain National Wildlife Refuge, and state and privately-owned lands.

The study area lateral boundaries were undefined by the legislation. However, the NPS set them at a quarter mile on either side of the river (a total area of 16,320 acres) the convention for Wild and Scenic River studies which was determined to incorporate important resources of the Reach. Lateral boundaries were later adjusted during the study process to include those resources identified during the scoping process which extend beyond the quarter mile boundary and are in federal ownership. These resources are in an area known as the Wahluke Slope, consisting of approximately 90,000 acres located north and east of the river. This land is currently administered by the USFWS as the Saddle Mountain National Wildlife Refuge and the WSDFW as the Wahluke State Wildlife Recreation Area. Both of these administratively designated wildlife areas are within the boundaries of the Hanford Site, but are operated through permits by the U.S. Fish and Wildlife Service (USFWS) and the Washington State Department of Fish and Wildlife (WSDFW), respectively.

South of the study area, the cities of Richland, Kennewick, and Pasco, commonly known as the Tri-Cities, form the nearest population center, one of ten major population centers in Washington state (Clements 1989). Other land within the study area is owned and managed by Grant County Public Utility District, the WSDFW, Washington Department of Natural Resources (WDNR), Bureau of Land Management (BLM), USFWS, and Bureau of Reclamation (BR). The remaining acreage is managed by the DOE.



HF PNL 1978a

R-0030

PNL-2499

UC-70

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## Comparative Ecology of Nuclear Waste Ponds and Streams on the Hanford Site

Richard M. Emery  
M. Colleen McShane

---

October 1978

Prepared for the U.S. Department of Energy  
under Contract No. EY-76-G-06-1830

Pacific Northwest Laboratory  
Operated for the U.S. Department of Energy  
by

 **Battelle**  
Memorial Institute

PNL-2499

**HF PNL 1991a**

**PNL-7668**

**UC-630**

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## **Characterization of the Hanford Site and Environs**

**Editor:**

**C. E. Cushing**

**Technical Contributors:**

**J. C. Chatters**

**D. L. Hadley**

**D. J. Hoitink**

**S. J. Marsh**

**T. M. Poston**

**A. C. Rohay**

**R. W. Wallace**

---

**March 1991**

**Prepared for the U.S. Department of Energy  
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**Pacific Northwest Laboratory  
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**PNL-7668**

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## **Hanford Site National Environmental Policy Act (NEPA) Characterization**

**C. E. Cushing, Editor**

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**December 1991**

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## **Hanford Site National Environmental Policy Act (NEPA) Characterization**

**C. E. Cushing, Editor**

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## **Hanford Site Environmental Report for Calendar Year 1993**

### **Scientific Editors**

R. L. Dirkes  
R. W. Hanf  
R. K. Woodruff

### **Technical Editor**

R. E. Lundgren

June 1994

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the U.S. Department of Energy  
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Pacific Northwest Laboratory  
Richland, Washington 99352



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PNL-10082  
UC-402,403

## **Hanford Site Ground-Water Monitoring for 1993**

P.E. Dresel  
S.P. Luttrell  
J.C. Evans  
W.D. Webber  
P.D. Thorne  
M.A. Chamness  
B.M. Gillespie  
B.E. Opitz  
J.T. Rieger  
J.K. Merz

September 1994

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Richland, Washington 99352

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WHC-EP-0554

UC-702

## Vascular Plants of the Hanford Site

M. R. Sackschewsky  
D. S. Landeen  
Westinghouse Hanford Company

G. I. Baird  
University of Texas

W. H. Rickard  
J. L. Downs  
Pacific Northwest Laboratory

Date Published  
July 1992

Prepared for the U.S. Department of Energy  
Office of Environmental Restoration and  
Waste Management



**Westinghouse  
Hanford Company**

P.O. Box 1970  
Richland, Washington 99352

Hanford Operations and Engineering Contractor for the  
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Approved for Public Release

### 3.0 HANFORD SITE PLANT SPECIES OF CONCERN

A number of plant species on or very near the Hanford Site are listed by the Washington Natural Heritage Program as endangered, threatened, sensitive, or monitor (Washington Natural Heritage Program 1990). Five of these species are also listed by the federal government as candidates for protection under the *Endangered Species Act of 1973* (55 FR 6184). Table 3-1 provides a listing of these plants. Pages D-1 and D-2 of Appendix D provide photographs of some of these plants. This list is based on the latest available information; however, the status of a particular species is always subject to change at the discretion of the responsible state and federal agencies. Additional information about these species, their distributions, and the possible effects of characterization activities is available in Sackschewsky (1992).

At least 12 plant species that are considered to be endangered, threatened, or sensitive by the Washington Natural Heritage Program (1990) are known to occur on or near the Hanford Site. Of these species, two are classified by Washington State as endangered, two are listed as threatened, and eight are listed as sensitive. All four species listed as State Threatened and State Endangered are listed as candidates for federal protection under the Endangered Species Act. None of the State Sensitive species are currently candidates for federal protection. A species is considered endangered by the state of Washington if it is in danger of becoming extinct or extirpated in the state of Washington in the near future if factors contributing to its decline continue. A species is listed by the state as threatened if it is likely to become endangered in the near future if factors contributing to its decline are not reversed. A species is considered sensitive if it is vulnerable or declining and could become threatened or endangered without active management or removal of threats. Four additional sensitive species have been reported by St. John and Jones (1928) or ERDA (1975) but have not been recently documented on the Hanford Site. Of the 12 known species, 5 occur along the shore of the Columbia River and 7 occur in various upland habitats. Currently there is no legal protection provided to any state listed plant species or to candidates for federal threatened or endangered species status.

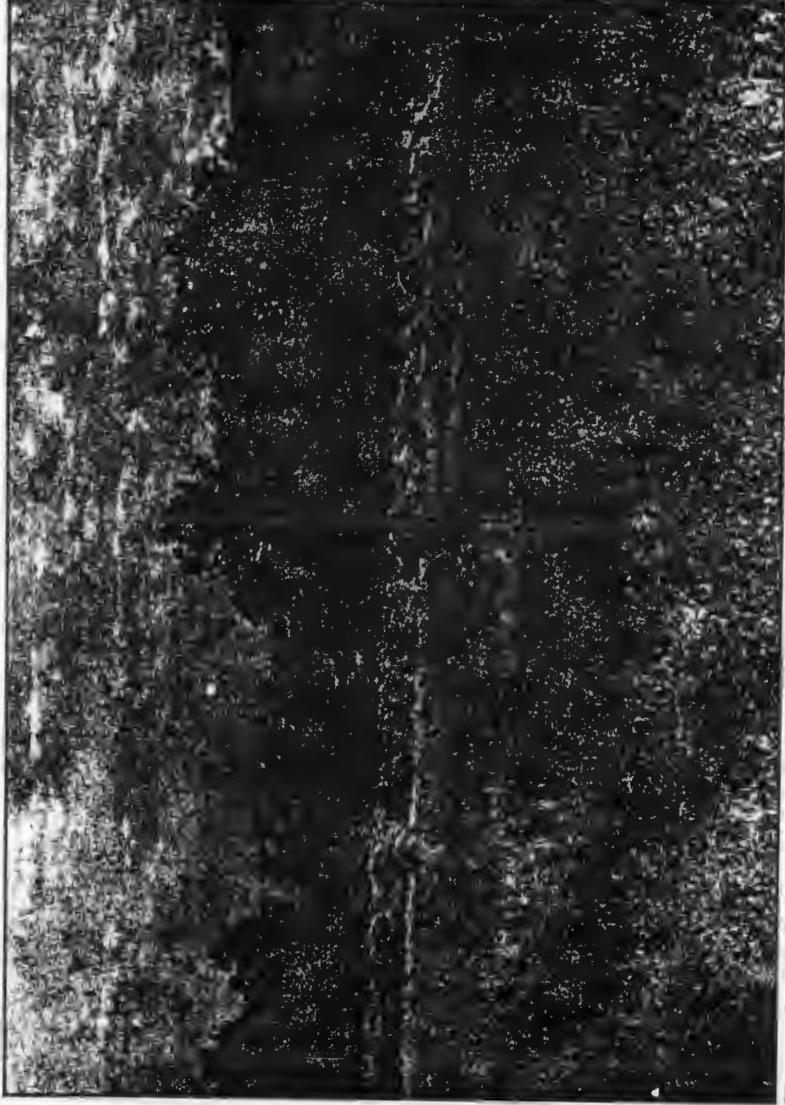
#### 3.1 WETLAND SPECIES

*Rorippa columbiae* (State Endangered, Federal Candidate): The Columbia or persistentsepal yellowcress is found at numerous locations along the shoreline and islands of the Columbia River. It is often found in open gravelly areas but can occur on sandy soil and in association with other species. It is usually found very near the waterline and is certainly submerged during periods of high water. The plants are short-lived perennials, and the seeds are often disbursed in the river; therefore, the populations tend to be found at different locations each year. Recent findings have been made at the Hanford Townsite, White Bluffs Ferry Landing, 100-D Area, and 100-B Area. Sauer and Leder (1985) reported findings of this species in the vicinity of the Vernita Bridge, the Hanford Townsite, and at a number of locations on the shore and islands of the Columbia River between the Hanford Townsite and the 300 Area. This species flowers and is easiest to identify during the late summer, normally during August.

*Limosella aquatica* (State Sensitive): The southern mudwort grows in shallow water or wet mud on the shoreline of the Columbia River. The species is known to occur within 0.25 mile of 100-B and 100-K Areas. Numerous other locations along the river would also provide suitable habitat. It flowers in the late summer.



Many wetland species can be found along the last free-flowing stretch of the Columbia River in the United States, which flows through the Hanford Site.



Trees planted by early settlers and by Manhattan Project workers remain at the area known as the Hanford Townsite, near the Columbia River.

Table 3-1. Hanford Site Plant Species of Concern. (sheet 1 of 2)

Species	Common name	Federal*	State*
<i>Artemisia campestris</i> ssp. <i>borealis</i> var. <i>wormskioldii</i>	northern wormwood	C <sub>1</sub>	E
<i>Rorippa columbiae</i>	Columbia yellowcress	C <sub>2</sub>	E
<i>Astragalus columbianus</i>	Columbia milkvetch	C <sub>2</sub>	T
<i>Lomatium tuberosum</i>	Hoover's desertparsley	C <sub>2</sub>	T
<i>Carex densa</i>	dense sedge	-	S
<i>Cryptantha interrupta</i>	bristly cryptantha	-	S
<i>Cryptantha leucophaea</i>	gray cryptantha	-	S
<i>Cyperus rivularis</i>	shining flatsedge	-	S
<i>Erigeron piperianus</i>	Piper's daisy	-	S
<i>Limosella acaulis</i>	southern mudwort	-	S
<i>Lindernia anagallidea</i>	false pimpernel	-	S
<i>Oenothera pygmaea</i>	dwarf desertprimrose	-	<del>S</del>
<i>Cuscuta denticulata</i>	desert dodder	-	M <sub>1</sub>
<i>Arenaria franklinii</i> var. <i>thompsonii</i>	Thompson's sandwort	C <sub>2</sub>	M <sub>2</sub>
<i>Allium robinsonii</i>	Robinson's onion	-	M <sub>1</sub>
<i>Allium scillioides</i>	squill onion	-	M <sub>1</sub>
<i>Artemisia lindleyana</i>	Columbia River mugwort	-	M <sub>1</sub>
<i>Astragalus sclerocarpus</i>	stalked-pod milkvetch	-	M <sub>1</sub>
<i>Astragalus speirocarpus</i>	medick milkvetch	-	M <sub>1</sub>
<i>Astragalus succumbens</i>	crouching milkvetch	-	M <sub>1</sub>

Table 3-1. Hanford Site Plant Species of Concern. (sheet 2 of 2)

Species	Common name	Federal*	State*
<i>Balsamorhiza rosea</i>	rosy balsamroot	-	M <sub>1</sub>
<i>Cirsium brevifolium</i>	Palouse thistle	-	M <sub>1</sub>
<i>Pellaea glabella</i>	smooth cliffbrake	-	M <sub>1</sub>
<i>Penstemon eriantherus</i>	fuzzy beardtongue	-	M <sub>1</sub>
Federal listings as of 2/21/90 - 55 FR 6184. State listings as of 6/90 - Washington Natural Heritage Program.			

**\*Federal Definitions**

- C<sub>1</sub> - Candidate taxa for which enough substantive information is available to support listing as threatened or endangered by the federal government.
- C<sub>2</sub> - Candidate taxa for which there is evidence of vulnerability, but not enough data to support listing proposals at this time.
- C<sub>3</sub> - Taxa that were once considered for listing as threatened or endangered, but are no longer candidates for listing. Sub-category (C<sub>3a</sub>) includes names that, on the basis of current taxonomic understanding, do not represent distinct taxa meeting the *Endangered Species Act of 1973* definition of "species."

**\*State Definitions**

- E - Endangered. Taxa that are in danger of becoming extinct within the near future if factors contributing to their decline continue.
- T - Threatened. Taxa that are likely to become endangered within the near future if factors contributing to their population decline or habitat degradation continue.
- S - Sensitive. Taxa that are vulnerable or declining, and could become endangered or threatened without active management or removal of threats.
- M<sub>1</sub> - Monitor Group 1. Taxa for which there is insufficient data to support listing as threatened, endangered, or sensitive.
- M<sub>2</sub> - Monitor Group 2. Taxa with unresolved taxonomic questions.
- M<sub>3</sub> - Monitor Group 3. Taxa that are more abundant and/or less threatened than previously assumed.

*Carex densa* (State Sensitive): dense sedge is found in the wetland area west of 100-B Area and has also been sighted along the shoreline of the Columbia River between 100-K and 100-N and between 100-N and 100-D Areas. Many other locations along the river also provide suitable habitat. It flowers in the summer.

*Lindernia anagallidea* (State Sensitive): false pimpernel, and *Cyperus rivularis* (State Sensitive): shining flatsedge. Both are found in wetland habitats in the vicinity of the 100-BC Area. Suitable habitat occurs at a number of other locations along the Columbia River. Both are most readily identifiable during the late summer.

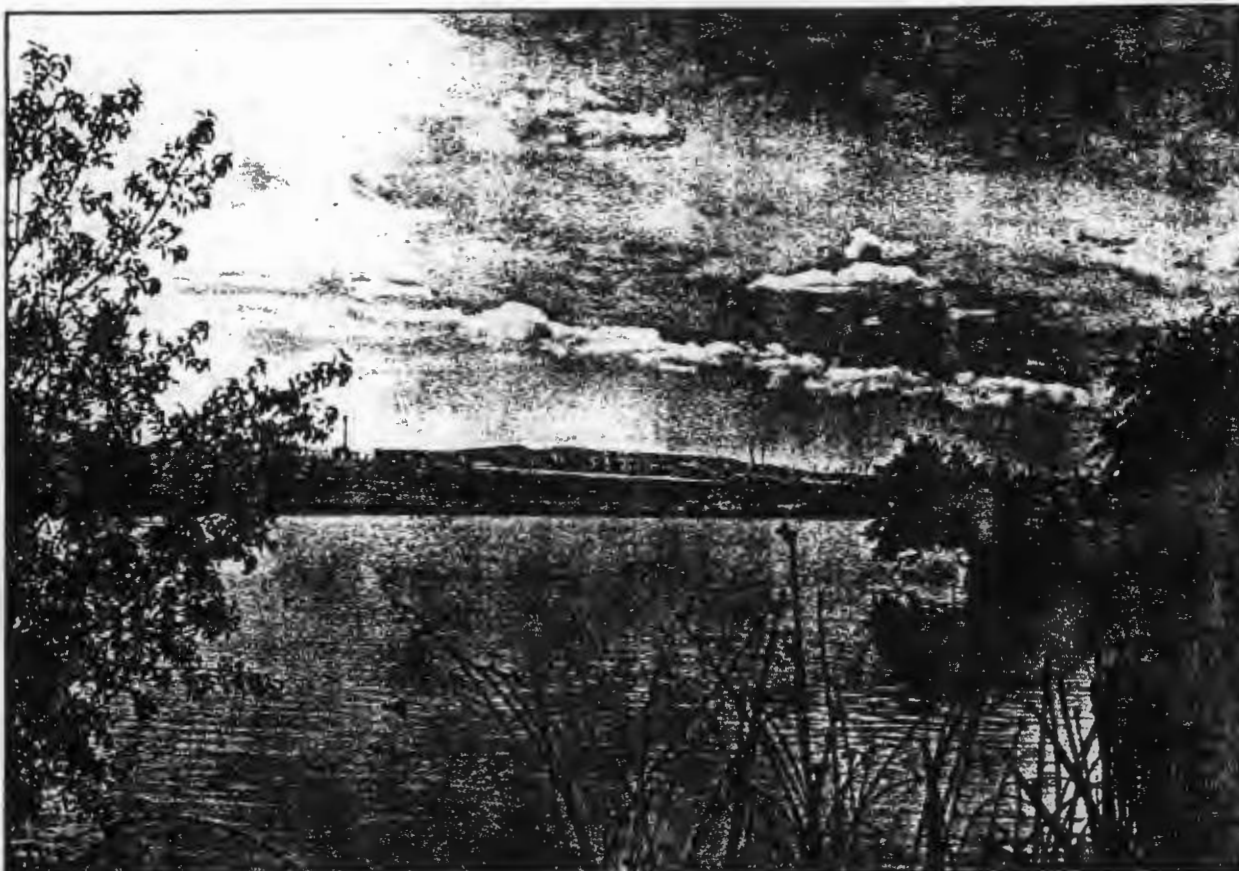
### 3.2 UPLAND SPECIES

*Artemisia campestris* ssp. *borealis* var. *wormskioldii* (State Endangered, Federal Candidate): northern wormwood. This taxon is known from only two populations in Washington State, one of which is located in a semi-disturbed, rocky flat adjacent to the Columbia River near Beverly. Other varieties of *A. campestris* are very common in similar habitats on the Hanford Site. The most obvious distinction between these varieties is flowering period. The *wormskioldii* variety flowers in April, while the other varieties flower during the summer. Because of the extreme rarity of var. *wormskioldii*, its known occurrence within 10 to 15 miles of the Hanford Site, and the large amount of suitable habitat along the shoreline and on the islands of the Columbia River, special emphasis should be given to the search for this species during biological surveys in the 100 Areas. This species was not detected during ecological surveys in the 100 Areas conducted during fiscal year 1991.

*Astragalus columbianus* (State Threatened, Federal Candidate): The Columbia milkvetch was once believed to be extinct but has since been found to be relatively common on the Yakima Firing Range. It has been found on the Hanford Site on top of Umtanum Ridge above the Midway substation. It is also known from very near the Hanford Site boundary in lowland areas on China Bar and in Cold Creek Valley. It is primarily associated with thinner sandy soils and could potentially be found at other locations on the Hanford Site. It normally flowers during April.

*Lomatium tuberosum* (State Threatened, Federal Candidate): Hoover's desertparsley is found on steep talus slopes near Priest Rapids Dam. Except for similar habitats on Gable Mountain and Gable Butte it is not expected to be found on the Hanford Site and it has yet to be found at these locations. It flowers very early, normally during mid-March.

*Erigeron piperianus* (State Sensitive): Piper's daisy is relatively common on Umtanum Ridge and has been found on a disturbed berm of B Pond near the 200 East Area. In other parts of Washington State it is usually associated with undisturbed, sandy, sagebrush steppe and could therefore be found in numerous locations on the Hanford Site. Although fairly small, it is very visible when in flower but can be confused with several other yellow composites, especially *E. linearis*. It flowers during May.



Piper's daisy has been found on a disturbed berm near B Pond, one of many ponds created at the Hanford Site as a result of man's activities.

*Cryptantha leucophaea* (State Sensitive): The gray cryptantha is found among sand dunes at a number of locations on the Hanford Site. Major populations are found near the railroad tracks in the vicinity of May Junction, 3 to 4 miles north of the Wye Barricade. A small population has also been found along Route 2 North, 0.5 mile east of 100-D Area. The bristly cryptantha (*C. interrupta*), also a State Sensitive species, has been found on Ringold Flats across the Columbia River from the Hanford Site. Both flower in spring, normally during May.

*Camissonia pygmaea* (State Sensitive): The dwarf desertprimrose is known from Ringold Flats and from a gravel pit about 1.5 miles north of the Wye Barricade. It is a diminutive plant that could easily be overlooked at other locations. It flowers during May.

### 3.3 OTHER SPECIES OF INTEREST

Several other species on the Hanford Site are of interest during ecological and biological investigations. The desert dodder (*Cuscuta denticulata*) has been found just off the far west end of the Hanford Site in Cold Creek Valley. This is apparently the only known finding of this species in the state of Washington. The Washington Natural Heritage Program lists it as a Type I Monitor species, meaning that additional data are needed before a formal categorical listing can be assigned.

Thompson's sandwort (*Arenaria franklinii* var. *thompsonii*) has received some interest in the past. However, botanists from the Washington Natural Heritage Program now feel that all individuals of the species *A. franklinii* in the state of Washington belong to the variety *franklinii* and have listed it as a Type II Monitor species, meaning that more taxonomic work needs to be performed before a formal classification can be made. If the Hanford Site plants are of variety *thompsonii*, the taxon would probably be listed as either threatened or sensitive. Individuals of this taxon are found in sandy areas or on open sand dunes throughout the Hanford Site.

A number of species that occur on the Hanford Site are listed as Type III Monitor species by the Washington Natural Heritage Program. This means that these species are more abundant or less threatened than previously thought. Even though these species are not considered to be in danger at this time, they are still of interest because they tend to indicate tracts of relatively undisturbed, native vegetation. Species in this category include Robinson's onion (*Allium robinsonii*), stalked-pod milkvetch (*Astragalus sclerocarpus*), crouching milkvetch (*Astragalus succumbens*), rosy balsamroot (*Balsamorhiza rosea*), Columbia River mugwort (*Artemisia lindleyana*), Palouse thistle (*Cirsium brevifolium*), smooth cliffbrake (*Pellaea glabella*), and fuzzy beardtongue (*Penstemon eriantherus*).

Several additional species listed as sensitive by the Washington Natural Heritage Program included in previous plant lists for the Hanford environs are also listed for reference purposes elsewhere in this document but have not been included on this list of species of concern. *Astragalus arrectus*, or Palouse milkvetch, was reported by St. John and Jones (1928) to occur in the Rattlesnake Hills; however, the specimen they refer to (collected by Miss Ruth Bennett) has not been found, and the specimen in question may have been confused with *A. leibergii* or *A. reventiformis*. *Astragalus arrectus* is otherwise not known from Benton County. It occurs primarily in Lincoln and Whitman Counties north and east of the Hanford Site and in Klickitat County southwest of the Hanford Site. *Collinsia sparsiflora*, or sparse blue-eyed Mary, was reported in ERDA (1975), apparently based on a specimen collected by the O'Farrells (O'Farrell 74-304) that could not be located. The only confirmed occurrences of this species in Washington State have been in Klickitat County. Most likely the O'Farrell specimen is the very similar *C. parviflora* (small blue-eyed Mary). *Nicotiana attenuata* (coyote tobacco) was reported by St. John and Jones (1928) to occur in the Rattlesnake Hills. The referenced specimen (Cotton 477) was located in the Washington State University herbarium, but an exact collection location is not provided on the specimen label. This species is known from Yakima, Franklin, and Grant Counties but has not been reported from Benton County, except in the 1928 publication by St. John and Jones. The Cotton specimen was collected in 1901, so the species may have simply become extirpated from Benton County.

A special note should also be made of *Hackelia diffusa*; the variety *diffusa* of this species is recognized by the Washington Natural Heritage Program as a sensitive species. Hitchcock and Chronquist (1973) recognize *H. diffusa* and *H. arida* as separate species; however, in a subsequent taxonomic treatment Gentry and Carr (1976) grouped both of these species under *H. diffusa* and recognized each as a separate variety. Plants found on or near the Hanford Site tend to key out to either *H. diffusa* or *H. arida*, depending on the population, when the flora by Hitchcock and Chronquist is used. Gentry and Carr recognized an additional variety, *cottonii*, which gradates into var. *arida* in the vicinity of the Hanford Site. The type specimen for variety *cottonii* (Cotton 360) was collected in the Rattlesnake Hills on or very near what is now the Hanford Site by J.S. Cotton in 1901. All of the specimens from the vicinity of the Hanford Site can probably be defined as intermediate between vars. *cottonii* and *arida*. The Hanford Site plant list provided in ERDA (1975) correctly included *H. diffusa* var. *cottonii*, even though this taxon is not included in the standard flora for the region (Hitchcock and Chronquist 1973).

**ID DHW 1991a**

**REVIEW OF CLARK COUNTY CANCER DATA:  
MORBIDITY (1978-1987)  
MORTALITY (1950-1989)**

**DIVISION OF HEALTH  
IDAHO DEPARTMENT OF HEALTH AND WELFARE**

**Janet M. Wick  
Supervisor, Health Statistics Section  
Cooperative Center for Health Statistics**

**Fritz R. Dixon, M.D.  
State Epidemiologist**

**May 1991**

ID

DHW 1991b

**REVIEW OF MINIDOKA COUNTY CANCER DATA:  
MORBIDITY (1978-1987)  
MORTALITY (1950-1989)**

**DIVISION OF HEALTH  
IDAHO DEPARTMENT OF HEALTH AND WELFARE**

**Janet M. Wick  
Supervisor, Health Statistics Section  
Cooperative Center for Health Statistics**

**Fritz R. Dixon, M.D.  
State Epidemiologist**

**May 1991**

RULES FOR THE CONTROL OF AIR POLLUTION IN IDAHO

000. LEGAL AUTHORITY. The Board of Health and Welfare is authorized to promulgate rules for the Department of Health and Welfare governing air pollution pursuant to Sections 39-105 and 39-107, Idaho Code. (5-1-94)

001. TITLE AND SCOPE. These rules shall be cited as IDAPA 16.01.01, Rules of the Department of Health and Welfare, Title 1, Chapter 1, "Rules for the Control of Air Pollution in Idaho." These rules provide for the control of air pollution in Idaho. (5-1-94)

002. WRITTEN INTERPRETATIONS. The Department of Health and Welfare has written statements which pertain to the interpretation of the rules of this chapter, or to the documentation of compliance with the rules of this chapter. The written statements are available for public inspection and copying at cost at the Central Office of the Division of Environmental Quality, Department of Health and Welfare, 1410 N. Hilton, Boise, Idaho 83706 at (208) 334-5898. (5-1-94)

003. ADMINISTRATIVE APPEALS. Persons may be entitled to appeal final agency actions authorized under this chapter pursuant to IDAPA 16.05.03, Rules of the Department of Health and Welfare, Title 5, Chapter 3, "Rules Governing Contested Case Proceedings and Declaratory Rulings." (5-1-94)

004. CATCHLINES. Catchlines within this chapter are not to be utilized in the interpretation of the rules. (5-1-94)

005. DEFINITIONS. The purpose of Sections 005 through 008 is to assemble definitions used throughout this chapter. (5-1-94)

006. GENERAL DEFINITIONS. (5-1-94)

01. Absolute Potential to Emit. For purposes of Sections 525 through 538, the maximum rated capacity of a stationary source to emit a pollutant under its physical and operational design. Physical and operational limits, whether or not they are federally or state enforceable, shall not be treated as part of the stationary source's design. (5-1-94)

02. Act. The Environmental Protection and Health Act of 1972 as amended (Sections 39-101 through 39-130, Idaho Code). (5-1-94)

03. Actual Emissions. The emission rate, in mass per unit time, of an air pollutant from a stationary source or emissions unit, averaged over the two (2) year period which is representative of normal operation and which precedes a particular date or the date on which an application for a permit was filed. Actual emissions shall be calculated using actual operating hours, production rates, and types of materials processed, stored, or combusted during this time period, except that: (5-1-94)

a. The Department may allow the use of a different time period upon a determination that it is more representative of normal operation; (5-1-94)

b. The Department may consider emission rates specifically allowed in a permit to construct or operating permit to be equivalent to actual emissions if the State Implementation Plan demonstration of attainment and/or maintenance is explicitly based on the permitted emissions; and (5-1-94)

c. For any stationary source or emissions unit which has not yet begun normal operations, actual emissions shall be considered to be those allowed in the applicable permit to construct or operating permit. (5-1-94)

04. Air Pollutant/Air Contaminant. Any substance, including but not limited to, dust, fume, gas, mist, odor, smoke, vapor, pollen, soot, carbon or particulate matter or any combination thereof, regulated under the Act, 42 U.S.C. Sections 7401 through 7671q. these rules or any federal air quality regulation. (5-1-94)

RULES FOR THE CONTROL OF AIR POLLUTION IN IDAHO **ID DHW 1986**

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001. **TITLE AND SCOPE.** These rules shall be cited as IDAPA 16.01.01, Rules of the Department of Health and Welfare, Title 1, Chapter 1, "Rules for the Control of Air Pollution in Idaho." These rules provide for the control of air pollution in Idaho. (5-1-94)

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CAS NUMBER	SUBSTANCE	OEL (mg/m3)	EL (lb/hr)	AAC (mg/m3)
96-18-4	1,2,3-Trichloropropan	300	20	3
121-44-8	Triethylamine	40	2.67	0.4
1582-09-8	Trifluralin (PL3)	---	---	1.15
552-30-7	Trimellitic anhydride	0.04	0.003	0.0004
75-50-3	Trimethylamine	24	1.6	0.24
25551-13-7	Trimethyl benzene (mixed and individual isomers)	123	8.2	1.23
540-84-1	2,2,4-Trimethyl- pentane	350	23.3	3.5
121-45-9	Trimethyl phosphite	10	0.667	0.1
479-45-8	2,4,6-Trinitrophenyl- methylnitramine, see Tetryl			
78-30-8	Triorthocresyl phosphate	0.1	0.007	0.001
603-34-9	Triphenyl amine	5	0.333	0.05
115-86-6	Triphenyl phosphate	3	0.2	0.03
7440-33-7	Tungsten Including: Insoluble compounds	5	0.333	0.05
NA	Soluble compounds	1	0.067	0.01
8006-64-2	Turpentine	560	37.3	5.6
7440-61-1	Uranium (natural) Soluble & insoluble compounds as U	0.2	0.013	0.002
110-62-3	n-Valeraldehyde	175	11.7	1.75
1314-62-1	Vanadium, as V2O5 Respirable Dust & fume	0.05	0.003	0.0005
108-05-4	Vinyl acetate	30	2	0.3
25013-15-4	Vinyl toluene	240	16	2.4
8032-32-4	VM & P Naphtha	1370	91.3	13.7
81-81-2	Warfarin	0.1	0.007	0.001
1330-20-7	Xylene (o-, m-, p-isomers)	435	29	4.35
1477-55-0	m-Xylene a,a-diamine (CL)	0.1	0.0007	0.0001
1300-73-8	Xylidine	10	0.667	0.1
7440-65-5	Yttrium (Metal and compounds as Y)	1	0.067	0.01
7440-66-6	Zinc metal (ID)	--	0.667	0.1
7646-85-7	Zinc chloride fume	1	0.067	0.01
1314-13-2	Zinc oxide fume	5	0.333	0.05
1314-13-2	Zinc oxide dust	10	0.667	0.1
7440-67-7	Zirconium compounds as Zr	5	0.333	0.05

(5-1-94)

586. TOXIC AIR POLLUTANTS CARCINOGENIC INCREMENTS. For all sources constructed or modified since May 1, 1994, the net screening emissions levels (EL) and acceptable ambient concentrations (AACC) for carcinogens which are not specifically controlled elsewhere in these rules, are as provided in the following table.

TABLE

CAS NUMBER	SUBSTANCE	URF	EL lb/hr	AACC ug/m3
75-07-0	Acetaldehyde	2.2E-06	3.0E-03	4.5E-01
79-06-1	Acrylamide	1.3E-03	5.1E-06	7.7E-04
107-13-1	Acrylonitrile	6.8E-05	9.8E-05	1.5E-02

CAS NUMBER	SUBSTANCE	URF	EL lb/hr	AACC ug/m3
309-00-2	Aldrin	4.9E-03	1.3E-06	2.0E-04
62-53-3	Aniline	7.4E-06	9.0E-04	1.4E-01
140-57-8	Aramite	7.1E-06	9.3E-04	1.4E-01
NA	Aroclor, all (PCB) (ID)	---	6.6E-05	1.0E-02
7440-38-2	Arsenic compounds	4.3E-03	1.5E-06	2.3E-04
1332-21-4	Asbestos (Fibers /M.L.)	2.3E-01	N/A	4.0E-06
71-43-2	Benzene	8.3E-06	8.0E-04	1.2E-01
92-87-5	Benzidine	6.7E-02	9.9E-08	1.5E-05
50-32-8	Benzo(a)pyrene	3.3E-03	2.0E-06	3.0E-04
7440-41-7	Beryllium & compounds	2.4E-04	2.8E-05	4.2E-03
106-99-0	1,3-Butadiene	2.8E-04	2.4E-05	3.6E-03
111-44-4	Bis (2-chloro ethyl) ether	3.3E-04	2.0E-05	3.0E-03
542-88-1	Bis (chloromethyl) ether	6.2E-02	1.0E-07	1.6E-05
108-60-1	Bis (2-chloro-1- methyl-ethyl) ether	2.0E-05	3.3E-04	5.0E-02
117-81-7	Bis (2-ethylhexyl) phthalate	2.4E-07	2.8E-02	4.2E+00
7440-43-9	Cadmium and compounds	1.8E-03	3.7E-06	5.6E-04
56-23-5	Carbon tetra- chloride	1.5E-05	4.4E-04	6.7E-02
57-74-9	Chlordane	3.7E-04	1.8E-04	2.7E-03
67-66-3	Chloroform	2.3E-05	2.8E-04	4.3E-02
74-87-3	Chloromethane (methyl chloride)	3.6E-06	1.9E-03	2.8E-01
7440-47-3	Chromium (VI) & compounds as Cr+6	1.2E-02	5.6E-07	8.3E-05
NA	Coal Tar Volatiles as benzene			
NA	Coke oven emissions	6.2E-04	1.1E-05	1.6E-03
8001-58-9	Creosote (ID) See coal tar volatiles as benzene extractables			
50-29-3	DDT (Dichlorodi- phenyltrichloro- ethane)	9.7E-05	6.8E-05	1.0E-02
96-12-8	1,2-Dibromo-3- chloropropane	6.3E-03	1.0E-06	1.6E-04
75-34-3	1,1 dichloroethane	2.6E-05	2.5E-04	3.8E-02
107-06-2	1,2 dichloroethane	2.6E-05	2.5E-04	3.8E-02
75-35-4	1,1 dichloro- ethylene	5.0E-05	1.3E-04	2.0E-02
75-09-2	Dichloromethane (Methylene chloride)	4.1E-06	1.6E-03	2.4E-01
542-75-6	1,3 dichloropropene	3.5E-01	1.9E-07	2.9E-06
764-41-0	1,4-Dichloro-2- butene	2.6E-03	2.5E-06	3.8E-04
60-57-1	Dieldrin	4.6E-03	1.4E-06	2.1E-04
56-53-1	Diethylstilbestrol	1.4E-01	4.7E-08	7.1E-06
123-91-1	1,4 dioxane	1.4E-06	4.8E-03	7.1E-01
	Dioxin and Furans (2,3,7,8, TCDD & mixtures) Dioxin and Furan emissions shall be considered as one TAP and expressed as an equivalent emission of 2,3,7,8,			

CAS NUMBER	SUBSTANCE	URF	EL lb/hr	AACC ug/m3
TCDD based on the relative potency of the isomers in accordance with US EPA guidelines. Copies of EPA Interim procedures for estimating risks associated with exposures to mixtures of chlorinated dibenzo-p-dioxins and dibenzofurans (CDDs and CDFs). 1989 Updates are available by requesting EPA/625/3-89/016, March 1989 from ORD Publications (513) 684-7562.				
122-66-7	1,2-Diphenylhydrazine	2.2E-04	3.0E-05	4.5E-03
106-89-8	Epichlorohydrin	1.2E-06	5.6E-03	8.3E-01
106-93-4	Ethylene dibromide	2.2E-04	3.0E-05	4.5E-03
75-21-8	Ethylene oxide	1.0E-04	6.7E-05	1.0E-02
50-00-0	Formaldehyde	1.3E-05	5.1E-04	7.7E-02
76-44-8	Heptachlor	1.3E-03	5.1E-06	7.7E-04
1024-57-3	Heptachlor Epoxide	2.6E-03	2.5E-06	3.5E-04
118-74-1	Hexachlorobenzene	4.9E-04	1.3E-05	2.0E-03
87-68-3	Hexachlorobutadiene	2.0E-05	3.3E-04	5.0E-02
	Hexachlorocyclohexane, Technical	5.1E-04	1.3E-05	1.9E-03
319-84-6	Hexachlorocyclohexane (Lindane) Alpha (BHC)	1.8E-03	3.7E-06	5.6E-04
319-86-8	alpha Hexachlorocyclohexane	1.8E-03	3.6E-05	5.6E-03
319-85-7	Hexachlorocyclohexane (Lindane) Beta (BHC)	5.3E-04	1.3E-05	1.8E-03
319-86-8	b-Hexachlorocyclohexane	5.3E-04	1.3E-06	1.9E-04
58-89-9	Hexachlorocyclohexane (Lindane) Gamma (BHC)	3.8E-04	1.7E-05	2.6E-03
67-72-1	Hexachloroethane	4.0E-06	1.7E-03	2.5E-01
301-01-2	Hydrazine	2.9E-03	2.3E-06	3.4E-04
302-01-2	Hydrazine Sulfate	2.9E-03	2.2E-06	3.5E-04
56-49-5	3-methylcholanthrene	2.7E-03	2.5E-06	3.7E-04
75-09-2	Methylene Chloride	4.1E-06	1.6E-03	2.4E-01
101-14-4	4,4-Methylene bis(2-Chloroaniline)	4.7E-05	1.4E-04	2.1E-02
60-34-4	Methyl hydrazine	3.1E-04	2.2E-05	3.2E-03
7440-02-0	Nickel	2.4E-04	2.7E-05	4.2E-03
12035-72-2	Nickel Subsulfide	4.8E-04	1.4E-05	2.1E-02
7440-02-0	Nickel Refinery Dust	2.4E-04	2.8E-05	4.2E-02
79-46-9	2-Nitropropane	2.7E-02	2.5E-07	3.7E-05
55-18-5	N-Nitrosodiethylamine (diethylnitrosoamine) (DEN)	4.3E-02	1.5E-07	2.3E-05
62-75-9	N-Nitrosodimethylamine	1.4E-02	4.8E-07	7.1E-05
924-16-3	N-Nitrosodibutylamine	1.6E-03	4.1E-06	6.3E-04
930-55-2	N-Nitrosopyrrolidine	6.1E-04	1.1E-05	1.6E-03
684-93-5	N-Nitroso-N-methylurea (NMU)	3.5E-01	1.9E-08	2.9E-06
794-93-4	Panfuran S			

CAS NUMBER	SUBSTANCE	URF	EL lb/hr	AACC ug/m3
127-18-4	(see dihydroxy- methyl-furatrizine) Perchloroethylene (see tetrachloro- ethylene)			
82-68-8	Pentachloronitro- benzene (see Quintobenzene) Polyaromatic Hydro- carbons (Polycyclic Organic Matter)	7.3E-05	9.1E-05	1.4E-02
	For emissions of PAH mixtures, the following PAHs and shall be considered together as one TAP, equivalent in potency to benzo(a)pyrene: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, chrysene, indeno(1,2,3-cd)pyrene, benzo(a)pyrene. (WA)			
23950-58-5	Pronamide	4.6E-06	1.5E-03	2.2E-01
50-55-5	Reserpine	3.0E-03	2.2E-06	3.3E-04
1746-01-6	2,3,7,8-Tetra- chlorodibenzo- p-dioxin (2,3,7,8, -TCDD)	4.5.E+01	1.5E-10	2.2E-08
NA	Soots and Tars (ID) See coal tar volatiles as benzene extractables.			
79-34-5	1,1,2,2,tetrachloro- ethane	5.8E-05	1.1E-05	1.7E-02
127-18-4	Tetrachloroethylene	4.8E-07	1.3E-02	2.1E+00
79-00-5	1,1,2 - trichloro- ethane	1.6E-05	4.2E-04	6.2E-02
62-56-6	Thiourea	5.5E-04	1.2E-05	1.8E-03
8001-35-2	Toxaphene	3.2E-04	2.0E-05	3.0E-03
79-01-6	Trichloroethylene	1.3E-06	5.1E-04	7.7E-02
88-06-2	2,4,6 - Trichloro- phenol	5.7E-06	1.2E-03	1.8E-01
75-01-4	Vinyl chloride	7.1E-06	9.4E-04	1.4E-01

(5-1-94)

587. LISTING OR DELISTING TOXIC AIR POLLUTANT INCREMENTS. Persons may request the listing of any toxic substance or delisting of any toxic air pollutant in Sections 585 or 586 by filing a petition for adoption of rules in accordance with IDAPA 16.05.03, "Rules Governing Contested Cases and Declaratory Rulings." (5-1-94)

588. -- 589. (RESERVED).

590. NEW SOURCE PERFORMANCE STANDARDS. The owner or operator of any stationary source shall comply with 40 CFR Part 60 as applicable to the stationary source. (5-1-94)

591. NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS. The owner or operator of any stationary source shall comply with 40 CFR Part 61 and 40 CFR Part 63 as applicable to the stationary source. (5-1-94)

592. -- 599. (RESERVED).

600. RULES FOR CONTROL OF OPEN BURNING. The purpose of Sections 600 through 604 is to protect public health and welfare from air pollutants

RULES FOR THE CONTROL OF AIR POLLUTION IN IDAHO

000. **LEGAL AUTHORITY.** The Board of Health and Welfare is authorized to promulgate rules for the Department of Health and Welfare governing air pollution pursuant to Sections 39-105 and 39-107, Idaho Code. (5-1-94)

001. **TITLE AND SCOPE.** These rules shall be cited as IDAPA 16.01.01, Rules of the Department of Health and Welfare, Title 1, Chapter 1, "Rules for the Control of Air Pollution in Idaho." These rules provide for the control of air pollution in Idaho. (5-1-94)

002. **WRITTEN INTERPRETATIONS.** The Department of Health and Welfare has written statements which pertain to the interpretation of the rules of this chapter, or to the documentation of compliance with the rules of this chapter. The written statements are available for public inspection and copying at cost at the Central Office of the Division of Environmental Quality, Department of Health and Welfare, 1410 N. Hilton, Boise, Idaho 83706 at (208) 334-5898. (5-1-94)

003. **ADMINISTRATIVE APPEALS.** Persons may be entitled to appeal final agency actions authorized under this chapter pursuant to IDAPA 16.05.03, Rules of the Department of Health and Welfare, Title 5, Chapter 3, "Rules Governing Contested Case Proceedings and Declaratory Rulings." (5-1-94)

004. **CATCHLINES.** Catchlines within this chapter are not to be utilized in the interpretation of the rules. (5-1-94)

005. **DEFINITIONS.** The purpose of Sections 005 through 008 is to assemble definitions used throughout this chapter. (5-1-94)

006. **GENERAL DEFINITIONS.** (5-1-94)

01. **Absolute Potential to Emit.** For purposes of Sections 525 through 538, the maximum rated capacity of a stationary source to emit a pollutant under its physical and operational design. Physical and operational limits, whether or not they are federally or state enforceable, shall not be treated as part of the stationary source's design. (5-1-94)

02. **Act.** The Environmental Protection and Health Act of 1972 as amended (Sections 39-101 through 39-130, Idaho Code). (5-1-94)

03. **Actual Emissions.** The emission rate, in mass per unit time, of an air pollutant from a stationary source or emissions unit, averaged over the two (2) year period which is representative of normal operation and which precedes a particular date or the date on which an application for a permit was filed. Actual emissions shall be calculated using actual operating hours, production rates, and types of materials processed, stored, or combusted during this time period, except that: (5-1-94)

a. The Department may allow the use of a different time period upon a determination that it is more representative of normal operation; (5-1-94)

b. The Department may consider emission rates specifically allowed in a permit to construct or operating permit to be equivalent to actual emissions if the State Implementation Plan demonstration of attainment and/or maintenance is explicitly based on the permitted emissions; and (5-1-94)

c. For any stationary source or emissions unit which has not yet begun normal operations, actual emissions shall be considered to be those allowed in the applicable permit to construct or operating permit. (5-1-94)

04. **Air Pollutant/Air Contaminant.** Any substance, including but not limited to, dust, fume, gas, mist, odor, smoke, vapor, pollen, soot, carbon or particulate matter or any combination thereof, regulated under the Act, 42 U.S.C. Sections 7401 through 7671q. these rules or any federal air quality regulation. (5-1-94)

575. AIR QUALITY STANDARDS AND AREA CLASSIFICATION. Ambient Air Quality Standards. The purpose of Sections 575 through 587 is to establish air quality standards for the state of Idaho which define acceptable ambient concentrations of air pollutants consistent with established air quality criteria. (5-1-94)

576. GENERAL PROVISIONS FOR AMBIENT AIR QUALITY STANDARDS. (5-1-94)

01. Applicability. The ambient air quality standards established herein shall apply to all of the state. (5-1-94)

02. Standard Conditions. Where applicable, air quality measurements shall be corrected to a reference temperature of 25C and to a reference pressure of 760 millimeters of mercury absolute. (5-1-94)

03. Revisions. As pertinent air quality criteria information becomes available, such information shall be considered and new or revised air quality standards promulgated as appropriate. (5-1-94)

04. Control of Unregulated Contaminants. The absence of an air quality standard for a specific contaminant shall not preclude action by the Department to control such contaminants to assure the health, welfare and comfort of the people of the State. (5-1-94)

05. Methods. All measurement techniques for determining compliance with 40 CFR Part 50 shall be consistent with those specified in 40 CFR Parts 50 and 53. (5-1-94)

577. AMBIENT AIR QUALITY STANDARDS FOR SPECIFIC AIR POLLUTANTS. (5-1-94)

01. Particulate Matter. PM-10 - particles with an aerodynamic diameter less than or equal to a nominal ten (10) micrometers. (5-1-94)

a. Primary and Secondary Standards. Primary and secondary PM-10 standards are: (5-1-94)

i. Annual Standard. Fifty (50) micrograms per cubic meter, as an annual arithmetic mean -- never expected to be exceeded in any calendar year. (5-1-94)

ii. Twenty-four Hour Standard. One hundred fifty (150) micrograms per cubic meter as a maximum twenty-four (24) hour concentration -- never expected to be exceeded more than once in any calendar year. (5-1-94)

b. Attainment and Expected Exceedance Determination. For the purpose of determining attainment of the primary and secondary PM-10 standards, expected exceedances shall be determined in accordance with Appendix K of 40 CFR Part 50. (5-1-94)

02. Total Suspended Particulate (TSP). (5-1-94)

a. Primary Standards. Primary TSP air quality standards are: (5-1-94)

i. Annual Standard. Seventy-five (75) micrograms per cubic meter, as an annual geometric mean -- not to be exceeded in any calendar year. (5-1-94)

ii. Twenty-four Hour Standard. Two hundred sixty (260) micrograms per cubic meter, as a maximum twenty-four (24) hour concentration -- not to be exceeded more than once in any calendar year. (5-1-94)

b. Secondary Standards. Secondary TSP air quality standards are: (5-1-94)

i. Annual Standard. Sixty (60) micrograms per cubic meter, as an annual geometric mean -- not to be exceeded in any calendar year. (5-1-94)

ii. Twenty-four Hour Standard. One hundred fifty (150) micrograms per cubic meter, as a maximum twenty-four (24) hour concentration -- not to be exceeded more than once in any calendar year. (5-1-94)

03. Sulfur Oxides (Sulfur Dioxide). (5-1-94)

are: a. Primary Standards. Primary sulfur dioxide air quality standards (5-1-94)

i. Annual Standard. Eighty (80) micrograms per cubic meter (0.03 ppm), as an annual arithmetic mean -- not to be exceeded in any calendar year. (5-1-94)

ii. Twenty-four Hour Standard. Three hundred sixty-five (365) micrograms per cubic meter (0.14 ppm), as an maximum twenty-four (24) hour concentration -- not to be exceeded more than once in any calendar year. (5-1-94)

b. Secondary Standards. Secondary air quality standards are one thousand three hundred (1,300) micrograms per cubic meter (0.50 ppm), as a maximum three (3) hour concentration -- not to be exceeded more than once in any calendar year. (5-1-94)

c. Conflicting Standards. When more than one (1) standard is applicable, the interpretation that results in the most stringent standard shall apply. (5-1-94)

04. Ozone. Primary and secondary air quality standards are 0.12 ppm (two hundred thirty-five (235) micrograms per cubic meter) -- maximum one (1) hour concentration not expected to be exceeded more than once per year. (5-1-94)

05. Nitrogen Dioxide. Primary and secondary air quality standards are one hundred (100) micrograms per cubic meter (0.05 ppm) -- annual arithmetic mean. (5-1-94)

are: 06. Carbon Monoxide. Primary and secondary air quality standards (5-1-94)

a. Eight (8) Hour Standard. Ten (10) milligrams per cubic meter (9 ppm) -- maximum eight (8) hour concentration not to be exceeded more than once per year. (5-1-94)

b. One (1) Hour Standard. Forty (40) milligrams per cubic meter (35 ppm) -- maximum one (1) hour concentration not to be exceeded more than once per year. (5-1-94)

07. Fluorides. Primary and secondary air quality standards are those concentrations in the ambient air which result in a total fluoride content in vegetation used for feed and forage of no more than: (5-1-94)

a. Annual Standard. 40 ppm, dry basis -- annual arithmetic mean. (5-1-94)

b. Bimonthly Standard. 60 ppm, dry basis -- monthly concentration for two (2) consecutive months. (5-1-94)

c. Monthly Standard. 80 ppm, dry basis -- monthly concentration never to be exceeded. (5-1-94)

08. Lead. Primary and secondary standards for lead and its compounds, measured as elemental lead, are one and one-half (1.5) micrograms per

cubic meter (1.5 ug/m3), as a quarterly arithmetic mean -- not to be exceeded in any quarter of any calendar year. (5-1-94)

578. DESIGNATION OF ATTAINMENT, UNCLASSIFIABLE, AND NONATTAINMENT AREAS. (5-1-94)

01. Annual Review. The Department shall annually review the available ambient air quality data and when appropriate, redesignate areas as attainment, unclassifiable or nonattainment with the standards in 40 CFR Part 50. (5-1-94)

02. Boundaries. Boundaries for such areas will be based, as much as possible, on actual ambient concentrations and shall take into account such things as the location of air pollutant sources, modeled air quality concentrations, terrain, geographical boundaries and political jurisdictions. (5-1-94)

03. Area Designation. Designation of attainment and unclassifiable areas shall generally be made on a county basis. Redesignation of attainment or unclassifiable areas cannot intersect or be smaller than the area of impact of any major facility or major modification which establishes the baseline date or is subject to a PSD permit. (5-1-94)

04. Redesignations. Redesignations shall be adopted by the Department after public notice and opportunity for a public hearing and will be submitted by the Governor (or if delegated, the Director) to the U.S. Environmental Protection Agency. (5-1-94)

579. BASELINES FOR PREVENTION OF SIGNIFICANT DETERIORATION. (5-1-94)

01. Baseline Date(s). (5-1-94)

a. Major Source Baseline Date. January 6, 1975 in the case of particulate matter and sulfur dioxide; February 8, 1988 in the case of nitrogen dioxide. (5-1-94)

b. Minor Source Baseline Date. The earliest date after August 7, 1977 in the case of particulate matter and sulfur dioxide, and after February 8, 1988 in the case of nitrogen dioxide, that a major facility or major modification subject to PSD submits a complete application. A minor source baseline date is established for total suspended particulates, sulfur dioxide, or nitrogen dioxide if the area in which the new major facility or major modification would construct is designated attainment or unclassifiable under 42 U.S.C. Section 7407(d), and there would be a significant increase of the particular air pollutant. (5-1-94)

02. Baseline Area. Any intrastate area designated as attainment or unclassifiable under 42 U.S.C. Section 7407(d), in which the major facility or major modification establishing the minor source baseline date would construct or would have an air quality impact equal to or greater than a one (1) microgram per cubic meter (annual average) of the air pollutant for which the minor source baseline date is established. (5-1-94)

03. Baseline Concentration. The ambient concentration for a particular air pollutant which exists in the applicable baseline area on the applicable minor source baseline date. (5-1-94)

a. The baseline concentration shall represent: (5-1-94)

i. The actual emissions from sources in existence on the applicable minor source baseline date; and (5-1-94)

ii. The allowable emissions of major facilities and major modifications which commenced construction before the applicable major source baseline

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IN DOE 1978a

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Distribution Category:  
UC-11  
Environmental Control  
Technology and Earth  
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ECOLOGICAL STUDIES ON THE  
IDAHO NATIONAL ENGINEERING LABORATORY SITE  
1978 PROGRESS REPORT

O. D. Markham, Editor

Date Published - December 1978

Environmental Sciences Branch  
Radiological and Environmental Sciences Laboratory  
U.S. Department of Energy  
550 Second Street  
Idaho Falls, Idaho 83401

R-00163

IN DOE 1980a

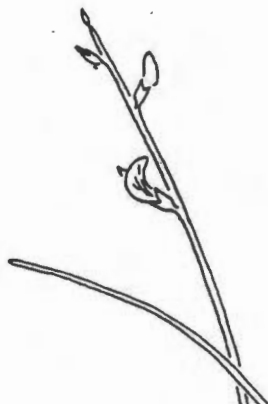
## FILE COPY

EPA PSD PERMIT AND STATE OF IDAHO  
PERMIT TO CONSTRUCT APPLICATIONS  
FOR THE U.S. DEPARTMENT OF ENERGY  
IDAHO NATIONAL ENGINEERING LABORATORY  
CHEMICAL PROCESS PLANT  
COAL-FIRED STEAM GENERATION FACILITY

December, 1980

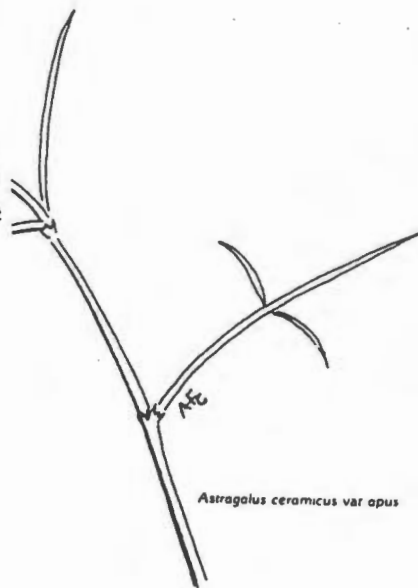
# A SURVEY AND ASSESSMENT OF THE RARE VASCULAR PLANTS OF THE IDAHO NATIONAL ENGINEERING LABORATORY

Anita F. Cholewa  
Douglass M. Henderson



## TRITIUM SUPPLY AND RECYCLING PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

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*Astragalus ceramicus var opus*

U.S. DEPARTMENT OF ENERGY

IDAHO OPERATIONS OFFICE

RADIOLOGICAL AND ENVIRONMENTAL SCIENCES LABORATORY

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DOE/ID-12100  
July 1984

A SURVEY AND ASSESSMENT OF THE RARE VASCULAR PLANTS  
OF THE IDAHO NATIONAL ENGINEERING LABORATORY

Anita F. Cholewa<sup>1</sup>  
and  
Douglass M. Henderson

University of Idaho Herbarium  
Department of Biological Sciences  
University of Idaho

Date Published - July 1984

Published by  
Radiological and Environmental  
Sciences Laboratory  
U. S. Department of Energy  
550 Second Street  
Idaho Falls, Idaho 83401

<sup>1</sup>Present address: Ownbey Herbarium, Washington State University, Pullman,  
Washington 99164-4309

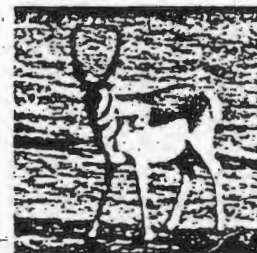
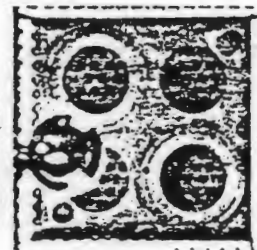
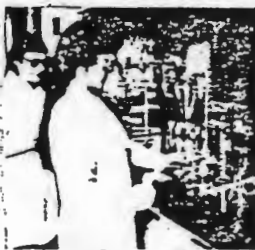
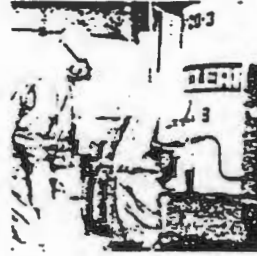
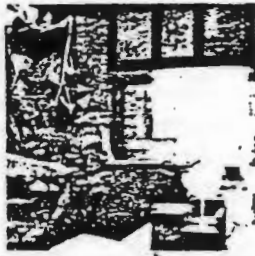
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IN DOE 1986a

# Site Characteristics

IDAHO NATIONAL ENGINEERING LABORATORY



Prepared for the U.S. Department of Energy  
Idaho Operations Office by EG&G Idaho, Inc.

Site Characteristics

# CLIMATOGRAPHY OF THE IDAHO NATIONAL ENGINEERING LABORATORY

**2<sup>nd</sup> Edition**

*December 1, 1989*

**Kirk L. Clawson**

**G. E. Start**

**Norman R. Ricks**

*Editors*

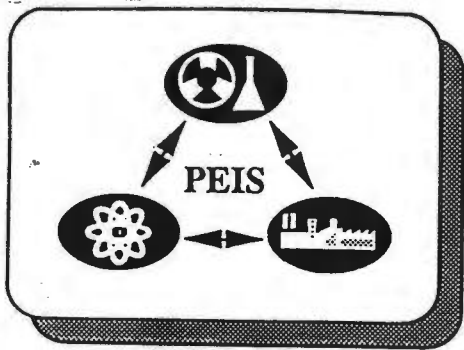
## TRITIUM SUPPLY AND RECYCLING PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

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**U. S. Department of Commerce  
National Oceanic and Atmospheric Administration  
Environmental Research Laboratories  
Air Resources Laboratory  
Field Research Division  
Idaho Falls, ID 83402**

**MASTER**

IN DOE 1991  
IN DOE 1991b



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## TRITIUM SUPPLY AND RECYCLING PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

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# Proposal for locating the Nuclear Weapons Complex Reconfiguration Site at the Idaho National Engineering Lab

June 3, 1991

Submitted to  
U.S. Department of Energy  
by the  
DOE Idaho Operations Office

IN DOE 1991e

**AIR EMISSION INVENTORY  
FOR THE  
IDAHO NATIONAL ENGINEERING LABORATORY**

**EXECUTIVE SUMMARY**

**U.S. DEPARTMENT OF ENERGY  
IDAHO OPERATIONS OFFICE**

**MARCH, 1991**



**TRITIUM SUPPLY AND RECYCLING  
PROGRAMMATIC ENVIRONMENTAL IMPACT  
STATEMENT**

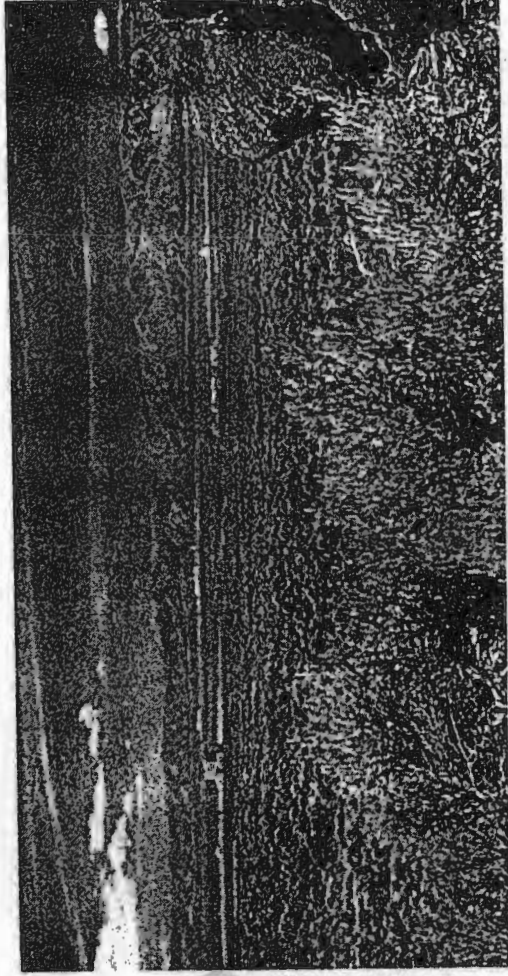
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DOE/ID-10390 (94), Revision 1

IN DOE 1992<sup>0</sup> Land  
Use at  
INEL

Idaho National Engineering Laboratory

# Site Development Plan



September 1994

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Idaho Operations Office

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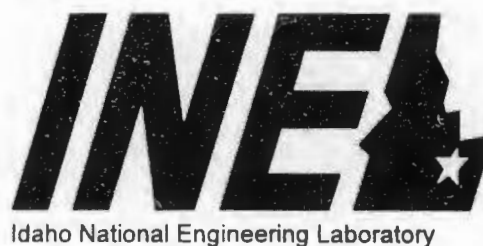
**IN DOE 1994c**

**The Idaho National Engineering Laboratory  
Site Environmental Report for  
Calendar Year 1993**

Environmental Science and Research Foundation

Russell G. Mitchell

July 1994



IN DOE 1994d

1.0 Land

Use at

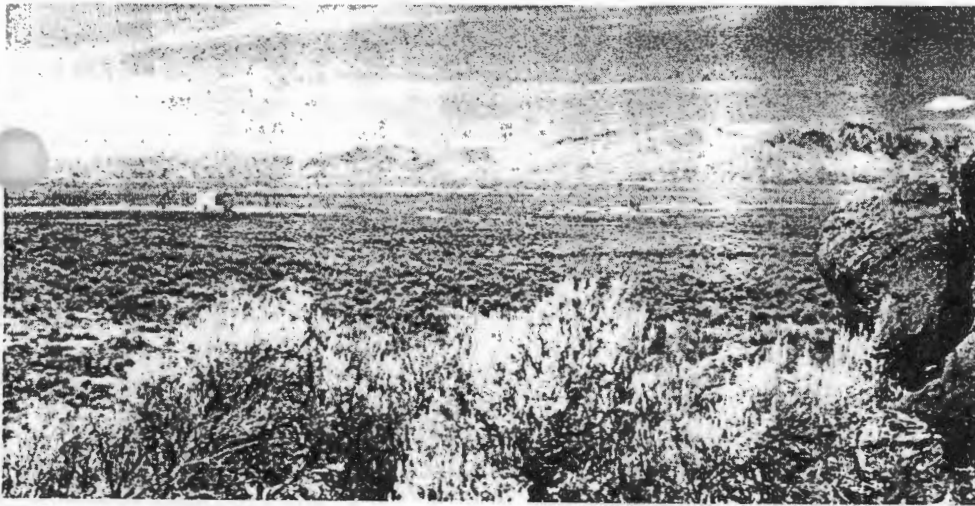
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DOE/ID-10390 (94), Revision 1

Idaho National Engineering Laboratory

# Site Development Plan



September 1994

3019

Idaho Operations Office

K94 0127

IN DOE 1995f

**Idaho National Engineering Laboratory  
Site Environmental Report for  
Calendar Year 1994**

Environmental Science and Research Foundation

July 1995



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EGG-NPR-8957

Rev 0

~~3/2/89~~ Rev # 2

NEW PRODUCTION REACTOR EXPOSURE PATHWAYS  
AT THE IDAHO NATIONAL ENGINEERING LABORATORY

David J. Thorne

Steven J. Maheras

Mike Abbott

#### 4.3. Surface Water

Most of the INEL is located in the Pioneer Basin, an informally-named and poorly-defined closed drainage basin. Surface water within the Pioneer Basin includes that from the Big Lost River, Little Lost River, and Birch Creek, all of which drain mountain watersheds located to the north and northwest of the INEL (Barracough et al., 1981). Most of the flow from the Little Lost River and Birch Creek is diverted for irrigation purposes prior to reaching the INEL. However, in very high flow years, Birch Creek flows into the Birch Creek playa (Figure 4) on the north end of the INEL and infiltrates into the subsurface. The Little Lost River flows onsite during high flow years and infiltrates into the subsurface.

The Big Lost River, the major surface water feature on the INEL, flows southeastward through the Big Lost River Basin past Arco, and passes onto the Eastern Snake River Plain. The river flows onto the INEL near its southwest boundary, curves to the northeast, and flows northward to the Big Lost River playas (sinks). In very high flow years the Big Lost River may overflow its own playas and enter the Birch Creek Playa.

All streamflow that enters the INEL is recharged to the aquifer, except for evaporation and transpiration losses. During dry periods, stream flow does not reach the INEL.

##### 4.3.1. Surface Water Data

Discharge flow data for Birch Creek, Little Lost River, and the Big Lost River are given in Bowman et al. (1985). The U.S. Geological Survey also monitors the hydrologic conditions at the INEL (Pittman et al., 1988).

##### 4.3.2. Pathway Examples

Three rainbow trout from the Big Lost River were analyzed for radioactivity during 1975 to 1977 and one sample had concentrations (1.2 pCi/g in muscle and 2.4 pCi/g in gut) above the minimum detection limit


TETRA TECH, INC.  


July 12, 1993

## TO WHOM IT MAY CONCERN:

The attached information was obtained from the Waste Management Information System (WMIS). WMIS is a data base that supports the Department of Energy (DOE), Office of Environmental Restoration and Waste Management, Office of Waste Operations. WMIS contains information on wastes produced by DOE's processing, manufacturing, and research activities, as well as information on DOE's treatment, storage, and disposal (T/S/D) capabilities. It is available to users nationwide and used by DOE Headquarters, field offices, and contractors to access information that can be used for strategic planning and reporting to government and private organizations. The WMIS data base currently contains two types of information, waste stream information and T/S/D capabilities. The attached information was obtained from the T/S/D unit capabilities part of the data base.

To request reports or to obtain more information about WMIS, please call or write:

Lise Wachter (   
Waste Management Information System  
Hazardous Waste Remedial Actions Program  
Martin Marietta Energy Systems, Inc.  
Post Office Box 2003, 831TCB, MS 7606  
Oak Ridge, TN 37831-7606



*IN USGS 1978b*

# Hydrologic Conditions at the Idaho National Engineering Laboratory, Idaho—Emphasis: 1974–1978

By Jack T. Barraclough, Barney D. Lewis, and  
Rodger G. Jensen

Prepared in cooperation  
with the U.S. Department  
of Energy

U.S. GEOLOGICAL SURVEY WATER-SUPPLY PAPER 2191

**INEL 1991a:6**

**RESPONSE TO THE INSTALLATION  
DATA CALL FOR THE PROGRAMMATIC  
ENVIRONMENTAL IMPACT STATEMENT**

**NUCLEAR WEAPONS COMPLEX RECONFIGURATION SITE**

**at the**

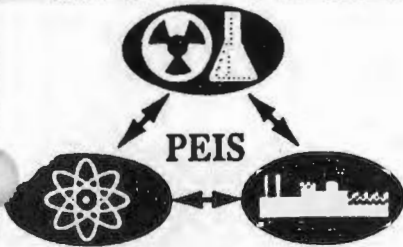
**IDAHO NATIONAL ENGINEERING LABORATORY**

**SOCIOECONOMIC**

**November 1991**

**U.S. Department of Energy  
DOE Field Office, Idaho**

INEL 1992a:2



# NWCR PEIS Telecon Note

CONTROL NO.: (circle one)

8N60 / 8N61 / 8N63 / 8N64 / 8N66  
8N67 / 8N69 / 8N70 / 8N71 / 8N72 / 3P57

DATE:

9/15/92

TIME:

3:30

**BETWEEN:**

Tim REYNOLDS

**OF:**

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**PHONE:**

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**AND:**

Л. Бонин

**FIRM:**

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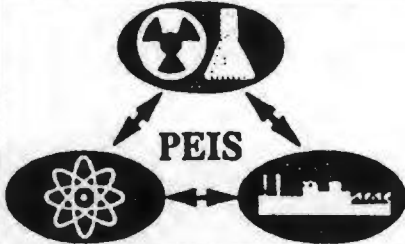
**DISCUSSION:**

I called in response to a statement made in the INR Streamer that I made regarding hunting onsite. Hunting is allowed onsite in the northern portion of the site within  $\frac{1}{2}$  mile of the bordering agricultural areas to control depredation by pronghorn. Pronghorn are the only species hunted. A special permit is not required.

**DISTRIBUTION:**

DISTRIBUTION: HNU5: MRG / RPB / KAE

INEL 1992a:4



HALLIBURTON NUS Environmental Programs Center

# NWCR PEIS Telecon Note

4.2.2.6  
~~5.6.5.5~~  
ag n. 9/2

CONTROL/CHRONOLOGY NO. (circle one):

8K23 / 8K24 / 8K25 / 8K26

DATE:

2/5/92

TIME:

3:30

BETWEEN:

Ken Moore

OF:

INEL

PHONE:

( )

AND:

J.R. Schinner

DEPT.:

EPNCD/HNUS

DISCUSSION:

A conference call was held in order to gather additional information

on the INEL site. Representing HNUS were J. Chaconas, J. Sechen  
J. Schinner and J. MacConnell. Questions and responses are attached.

ACTION:

DISTRIBUTION:

HNUS: MRG/RPB/KAE

OTHER: J. Chaconas, J. MacConnell, J. Sechen

## IDAHO NATIONAL ENGINEERING LABORATORY

### Terrestrial Resources

1. Have studies been undertaken to identify flora and fauna of the NWCRS?

Studies has not been conducted on the flora and fauna of the NWCRS.

2. Is a plant community map available for the NWCR and NPR sites?

No, however, they do have a GIS system from which a site habitat map could be generated. Kurt Eckerstrom could call Ken Moor regarding sending us a file. They are doing accuracy studies on the site vegetation map which should be available in the spring. One of his biologists (Doyle Markham) has been to the NWCR site. He can be contacted at (208) 526-2164.

3. Are tables available that identify the acreage of each plant community type present in the INEL, as well as the NWCR and NPR sites?

No, see Item 2 above.

4. What is the status of the revegetation program? When will it be complete? Is a map and time schedule available?

There is no site wide revegetation program. Specific project areas are revegetated with native species as required.

5. Do pronghorn antelope use either the NWCR or NPR sites?

Doyle Markham may have additional information relating to antelope as well as other species onsite. There is no evidence of heavy use of the sites. Big game species have caused problems on neighboring property by eating crops.

6. Any change in the status of pronghorn or elk onsite?

For example - Do 30% of the pronghorn in the state still winter on INEL? Have elk numbers increased?

The University has monitored pronghorn and Doyle Markham should have details of studies. Movement of pronghorn is on their GIS. Elk numbers have increased since the report that notes 2 groups of 40 animals on the site. A report on elk is due out in the spring (a copy will be sent).

7. Is hunting permitted onsite?

Special hunts have been held. Elk are the species hunted the most. Doyle Markham has information on this subject.

8. Is the following reference available?

Reynolds, T.D. 1988. Seasonal abundance and distribution of pronghorn on the Idaho National Environmental Research park. p 6. In M. Hess (Chairman) Proceedings, 12th Biennial Pronghorn Antelope Workshop, Renov, NV. March 11-13, 1986. NV Dept. Wildl. Spec. Publ. 101 p.

Contact Doyle Markham regarding this publication.

9. What percent of the site is occupied by production facilities?

Approximately 2 - 3 percent.

Wetlands

1. Wetlands Map for site based on Cowardin System, if possible, one that shows entire site (not just the Idaho Chemical Processing Plant and proposed NPR sites).

GIS showing among other things wetlands for site available this spring. FWS is doing site wetland study due to be completed this spring. Talk to Doyle Markham for more information.

2. Any wetland related correspondence, maps or delineations performed by or for the Corps of Engineers or State level wetland regulators.

FWS is currently doing study. Corps has not been on site for wetland related activities.

3. Soil information outside of proposed NPR sites (i.e., site specific or county soil survey maps and soil descriptions).

Soil map prepared by Breconridge and McGrath (most recent is 1989 update) discusses soil series with emphasis on agricultural uses.

4. Any information concerning wetlands of special interest or concern.

There are not wetlands on site of special interest or concern.

5. Additional notes.

Man-made ponds on site are almost all contaminated with rad and non-rad contamination. Typically ponds are 100 x 50 yds. x 10 ft. deep. Will be discussed in Use of Ponds at INEL by Wildlife due out this spring. Pond locations will be shown on GIS. Ken will send.

Ken confirmed that the Big Lost River has not contained flowing water since 1986.

Aquatic Resources

1. Were any aquatic surveys conducted of Birch Creek, Little Lost River and playas 1, 2, 3, 4?

There have been no surveys conducted since these surface water bodies are intermittent. There may be fish upstream of the site in Birch Creek and the Big Lost River.

2. Is there any aquatic life in any of the liquid-waste disposal ponds?

There are no fish. There was a study conducted of the benthos in the argonne ponds. This information will be sent to HNUS.

Threatened and Endangered Species

1. Need to verify occurrence of threatened and endangered species on the NWCRS.

- No activity on the NWCRS, occurrence of the species can not be verified but may be presumed to be similar to NPR site as described in Draft EIS for NPR.
- Doyle Markham (DOE) is in charge of field work on the NWCRS (208) 526-2164.
- Tim Reynolds works with Doyle and is knowledgeable on T&E species. Associated with USFWS through Radiological Environmental Services Lab (RESL).

2. There is some confusion in the species status as listed according to the state or BLM.

Ken Moore tried to explain the state policy on species of concern and their protection - this issue is still unclear and does not explain why certain species are listed in the NPR EIS as "species of concern" and which are on the BLM list. Need to contact Dr. Tim Reynolds of

4.2.2.6  
~~4.2.2.6~~  
By Ken  
H 2

DOE to help clarify issue. What lists are being used to define state species of concern and which species are believed to be onsite?

3. Check document references for most current T&E review, need copy for state and federal species.

- Apparently there is a letter from USFWS to DOE describing T&E species to be addressed on INEL and a follow-up letter clarifying the USFWS statement. Copies of these were sent to Tetra Tech but I can not locate them. I will contact Ken Moore to get copies.
- The state position on T&E species has not been verified to my understanding. I will contact Tim Reynolds to clarify this issue.

4. Other items of interest:

- The state has issued a report on "State Wildlife and Their Status." Contact Doyle Markham for copy.
- A report on Use of Ponds by INEL Wildlife will be available in the spring. Small flocks of migrating waterfowl and shorebirds use small ponds (100 x 50 yds.) on INEL.

INEL 1993a:5

**INEL**

**NO ACTION DATA PACKAGE**

**ENCLOSED:  
TABS AND 1992 SITE  
DEVELOPMENT PLAN**

**(NO COVER LETTER WAS ATTACHED)**

**RECEIVED  
OCTOBER 7, 1993**

D  
3018  
B

#### Transuranic Waste (TRUW)

The volume of TRUW at the INEL depicted on the table includes TRUW received from off site generators. The INEL is projected to generate less than 1 m<sup>3</sup>/yr. However, Argonne-East continues to ship TRUW to the INEL. The estimated annual volume of TRUW on site in 2002 is estimated to be essentially the same under Alternatives A and B. The 2002 inventory includes TRUW from ER and D&D actions, as they are presently known.

#### Low-Level Waste (LLW)

The volume of LLW shown in the table for 1992 is based on shipment records which is the basis for recording waste volumes. However, a large volume of LLW has accumulated at points of generation. This LLW is estimated to be 9500 m<sup>3</sup> and has not been entered into the official waste data base, but has been stockpiled in anticipation of the restart of treatment operations. The estimated annual rate of LLW generation is therefore based on a 1987-1992 average of LLW generated onsite. The added volume of LLW disposed through 2002 is depicted for Alternatives A and B. These volumes reflect the estimated difference between the volume of LLW generated and the volume disposed following treatment. Volume reduction is based on the per cent of LLW that is estimated to be suited for incineration, compaction, and seizing.

Generation rates for SCW and GTCC are not provided due to uncertainties about the generation of these wastes and their acceptance at the INEL. Consequently the volume of these wastes through 2002 are not shown to change.

#### Hazardous Waste (HW)

No hazardous waste is shown in inventory in the table because HW is disposed offsite at commercial waste treatment, storage, and disposal facilities. In 1992, 835 m<sup>3</sup> of HW were generated at the INEL. However, approximately 600 m<sup>3</sup> of this waste was polychlorinated biphenol contaminated soils from a onetime cleanup. General site operations and routine ER and D&D activities therefore generated only 235 m<sup>3</sup> of HW in 1992. This volume was used as a basis to bound and estimate future HW volumes at the INEL.

#### Mixed Waste (MW)

The annual volume of MW projected to be generated and shown in the table is based on the volume of MW that could be generated from several significant projects. These estimates are for five years only and

WASTE TYPE	CURRENT INVENTORY (m <sup>3</sup> )	1992 GEN. VOLUME (m <sup>3</sup> )	PROJ. ANNUAL BASELINE GEN. RATE (m <sup>3</sup> /yr)	INVENTORY AT 2002 (m <sup>3</sup> )	
				A-NO ACTION	B-PROPOSED ACTION 5-10/YR PLAN
SNF	410	NA	NA	410	NA
HLW	7900 L 3600 S	1200	750 L (A) 1100 S 1000 L (B) 1200 S	4500 L 5200 S	5300 <sup>+</sup> L 5400 S
TRUW	102175 CH-TRU 143 RH-TRU	< 1m <sup>3</sup>	< 1m <sup>3</sup>	109335 393	109335 393
LLW	145000	11,282	3900	40600 Gen (19260)Disp	50370 (25920) Disp
SCW GTCC	38000 25		NA NA	NA NA	NA NA
HW	NA (waste shipped off site)	835 (235)	235	8448	18361
MW	537	47	501	5139	5017
SW	770000	50800	52000	520066 <sup>(1)</sup>	522049 <sup>(1)</sup>

**Note:**

A = Alternative A.

B = Alternative B.

L = Liquid Waste.

S = Solid Waste.

Gen = Total volume generated by 2002.

Disp = Total volume disposed by 2002.

CH-TRU = Contact-handled TRU

RH-TRU = Remote-handled TRU

(1) Inventory includes SW created versus the amount disposed. Since SW is disposed includes waste due to ER and D&D activities.

## TAB B - Facility Operations/Site Infrastructure (INEL)

Provide current INEL data concerning facility operations and site infrastructure

Please verify the CY1992 information in column 2 for the first table and fill-in the projected data for the year 2005 in column 3. Projected data should account for transitional activities expected to occur under No Action as explained in the letter of instructions (LOI). Also, verify the major missions/functions listed in the second table, and the transitional activities (Table 3) that may affect the projected No Action data.

1	2	3
Environmental Characteristic	Most Current Information - CY 1992	No Action - CY 2005
<b>LAND</b>		
Area (acres)	570,000	570,000
Roads (miles)	277	277
Railroads (miles)	30	30
		Note 1
<b>ELECTRICAL</b>		
Energy (MWh/yr)	232,500	232,500
Load (MWe)	33	33
Peak Demand (MWe)	41.8	41.8
<b>FUEL</b>		
Natural Gas (sft <sup>3</sup> /yr)	0	0
Oil (gal/yr)	1,538,827	1,500,000
Coal (tons/yr)	12,500	12,500
<b>STEAM (BTU/yr)</b>	93E9	93E9

Note 1: See Site Development Plan for upgrades to existing infrastructure.

Note 2: Transition facility infrastructure are generically addressed in the Site Development Plan. Specific infrastructure and energy use requirements will not be available until process design is completed.

Table 1

**TAB B - Facility Operations/Site Infrastructure (INEL) (con't)**

Verify major waste management facilities that are due to become operational during the transition period at INEL.

Facility	Action (y(y
Idaho Waste Processing Facility	Become Operational
Lead Recycling Facility	Become Operational
Reactive Storage and Treatment Area	Become Operational
ICPP Decontamination Facility	Become Operational
Waste Characterization Facility	Become Operational
HRCWF Compactor	Become Operational
ICPP HEPA Leach System	Become Operational
Liquid Effluent Treatment and Disposal	Become Operational
Solid Waste Transfer Station	Become Operational
Waste Handling Facility (ANL-W)	Become Operational
Mixed/LLW Treatment Facility	Become Operational
New LLW Disposal Facility	Become Operational
Radioactive Sodium Waste Process Facility (ANL-W)	Become Operational

Table 3

1. Add Idaho Waste Immobilization Facility (ICPP)
2. The Lead Recycling Facility will not be operational.
3. Delete Reactive Storage and Treatment Area.
4. Delete HRCWF Compactor.
5. The Liquid Effluent Treatment and Disposal Facility is operational.
6. The Solid Waste Transfer Station will not be operational.
7. All other facilities are operational as indicated.

**TAB C - Air Quality (INEL)**

Column 2 lists the Affected Environment levels based on information from the year shown.

Verify the information in column 2 and fill-in the projected emissions for the year 2005 in column 3. Projected data must account for transitional activities or other operational changes expected to occur under No Action as explained in the LOI.

1

2

3

Criteria Pollutants	1990 Emissions (tons/yr)	2005 Emissions (tons/yr)
Carbon Monoxide	465	
Nitrogen Dioxide	1,393	
Particulate Matter (PM <sub>10</sub> )	406	
Sulfur Dioxide	2,087	
Total Suspended Particulate	844	
Volatile Organic Compounds	90	
Hazardous Air Pollutant (Toxic Chemical)	1990 Emissions (tons/yr)	2005 Emissions (tons/yr)
1,1,1 Trichloroethane	1.0	
Acetone	0.024	
Acetylene	0	
Ammonia	3.0	
Argon	0	
Carbon Dioxide	0	
Chlorine	0	
Cleaning Solvents	0	
Cyclohexane	0	
Dimethyl Formamide	0	

**TAB D - Surface Water (INEL)**

Fill in the missing data for the years 1991 and 2005 as appropriate.

Affected Resource Indicators	Affected Environment in Year 1991	Discharges in Year 1991	No Action - Year 2005
RECEIVING WATER	DISCHARGES TO RECEIVING WATER	AVERAGE AMOUNT (MGY) AND (MGD)	IDENTIFY DISCHARGES
Big Lost River	ICPP pumped water - leakage See Note 1	800 GPD 0.29 MGY	No discharges to surface waters.
	non contact cooling water	_0_ MGD	_0_ MGD/no discharges
	wastewater treatment plant effluent	_0_ MGD	_0_ MGD/no discharges
Issue: Confirm that the TSS and NFS are above the PMF combined with the failure of Mackay Dam		Response: See note 2	

1. The pressure relief valve on the water production well leaks 50 gallons per hour or 800 GPD for 16 hours pumping. This is 292,000 GPD or 0.29 MGY. This water discharged to the dry bed of the Big Lost River in 1991. The leak will be repaired prior to CY-2005. No other discharge to the Big Lost river occurred in 1991. No discharges are planned.
2. The elevation of the Big Lost River streambed at ICPP is 4911 ft. MSL. The elevation of the Big Lost River PMF combined with a failure of Mackay Dam is 4917 ft. MSL. The elevations at the ICPP range from 4910 FT MSL at the northeast edge of the Plant to more than 4920 ft. MSL at the southwest edge of the Plant. Limited flooding would occur because of existing and planned berms. The Big Lost River was dry in 1991.



# TAB I - Human Health - Normal Operations (INEL)

Column 1 in the table below lists facilities (facility areas) with past radiological emissions at INEL.

Column 2 lists the reference used to determine the normal radiological emissions from those facilities. These values will be used unless scaling factors or other references are provided.

In Column 3, indicate which facilities are expected to be operational in the year 2005 under No Action.

In Column 4, for those facilities expected to be operational in 2005, provide a scaling factor for the referenced source terms to reflect decreases or increases in radiological emissions due to expected changes in operational tempo compared to reference year activity. For example, if a facility is expected to operate in the year 2005 at 40% of the 1990 tempo, then the scaling factor would be .40.

In Column 5, indicate whether references cited are still valid. If not, please indicate the preferred valid document, and provide the document if not already listed at Tab 0.

1	2	3	4	5
Facility Area	Reference for Normal Operational Radiological Releases	Operational in 2005? (Yes/No)	Scale Factor	Valid Ref?
ANL-West	Table II-8 of <u>1990 INEL NESHAP Annual Report</u> , DOE/ID-10342	Y	100	Y
TRA	Table II-10 of <u>1990 INEL NESHAP Annual Report</u> , DOE/ID-10342	Y	100	Y
WERF and PBF	Table II-11 of <u>1990 INEL NESHAP Annual Report</u> , DOE/ID-10342	Y	100	Y
CFA	Table II-12 of <u>1990 INEL NESHAP Annual Report</u> , DOE/ID-10342	Y	100	Y
TAN	Table II-13 of <u>1990 INEL NESHAP Annual Report</u> , DOE/ID-10342	Note 1	0	Y
SMC	Table II-14 of <u>1990 INEL NESHAP Annual Report</u> , DOE/ID-10342	N	0	Y
NRF	Table II-15 of <u>1990 INEL NESHAP Annual Report</u> , DOE/ID-10342	N	0	Y

Note 1: Standby condition.

10/05/93

1992 RADIATION EXPOSURE DATA FOR THE INEL (Includes NRF and Argonne West)

Facility	Number of Workers	Collective Dose (mrem)	Average Worker Dose (mrem)	Maximum Individ Dose (mrem)
Fuel Fabrication	57	1,297	23	253
Fuel Processing	2,408	38,344	16	823
Maint. & Support	317	2,762	9	200
Reactor	1,771	42,294	24	873
General Research	1,588	48,603	31	1,276
Waste Process/Mgmt	271	1,035	4	105
Other	925	2,196	2	254
TOTAL INEL	7,337	136,531	19	1,276

1992 RADIATION EXPOSURE DATA FOR THE INEL (Includes Argonne West)

Facility	Number of Workers	Collective Dose (mrem)	Average Worker Dose (mrem)	Maximum Individ Dose (mrem)
Fuel Fabrication	57	1,297	23	253
Fuel Processing	2,408	38,344	16	823
Maint. & Support	317	2,762	9	200
Reactor	1,279	32,258	25	873
General Research	1,254	16,569	13	654
Waste Process/Mgmt	271	1,035	4	105
Other	925	2,196	2	254
TOTAL (excl. NRF)	6,511	94,461	15	873

1992 RADIATION EXPOSURE DATA FOR THE NRF

Facility	Number of Workers	Collective Dose (mrem)	Average Worker Dose (mrem)	Maximum Individu Dose (mrem)
Reactor	492	10,036	20	300
General Research	334	32,034	96	1,276
TOTAL NRF	826	42,070	51	1,276

*Includes NAF*

## INEL INJURY/ILLNESS EXPERIENCE BY CONTRACTOR

			T R C			L W C			LWC			* * LOST WORK DAYS * *			NON-FATAL TERMS		
EQUIV.			INCI-			INCI-			WITH			INCI-			CASES OR		
YR.	FULL-TIME		DENCE	DEATHS		DENCE	DEATHS		DAYS	AWAY	WDL	WDLR	NO.	RATE	LWD	TRANS	COST
QTR.	EMPLOYEES	HOURS	NO.	RATE		NO.	RATE										INDEX
Idaho Field Office																	
Government																	
91-4	599	1,137,440	12	2.1	0	9	1.6	4	43	12	55	9.7	3	0	3.89		
92-4	569	1,080,503	19	3.5	0	15	2.8	4	9	143	152	28.1	4	0	5.15		
93-2	532	505,394	1	0.4	0	1	0.4	0	0	3	3	1.2	0	0	1.50		
Argonne National Laboratory - West																	
Research																	
91-4	847	1,609,890	30	3.7	0	23	2.9	6	184	202	386	48.0	7	0	7.38		
92-4	866	1,646,282	30	3.6	0	21	2.6	8	55	134	189	23.0	9	0	5.33		
93-2	937	890,573	8	1.8	0	4	0.9	1	3	26	29	6.5	4	0	2.48		
Argonne-West Subcontractors																	
Lump Const																	
91-4	25	47,507	0	0.0	0	0	0.0	0	0	0	0	0.0	0	0	0.99		
92-4	35	65,880	1	3.0	0	1	3.0	1	1	0	1	3.0	0	0	5.09		
93-2	87	82,267	0	0.0	0	0	0.0	0	0	0	0	0.0	0	0	0.99		
Argonne-West Security Force																	
Security																	
91-4	48	90,827	3	6.6	0	3	6.6	1	1	50	51	112.3	0	0	10.85		
92-4	54	102,281	2	3.9	0	2	3.9	1	4	4	8	15.6	0	0	6.76		
93-2	60	56,760	0	0.0	0	0	0.0	0	0	0	0	0.0	0	0	0.99		
Protection Technology - INEL																	
Security																	
91-4	550	1,045,850	36	6.9	0	22	4.2	15	332	180	512	97.9	14	1	23.26		
92-4	505	959,370	25	5.2	0	17	3.5	16	173	1	174	36.3	8	0	9.45		
93-2	567	538,864	3	1.1	0	3	1.1	3	14	0	14	5.2	0	0	2.91		
EG&G Idaho, Inc.																	
Research																	
91-4	5176	9,834,402	136	2.8	0	77	1.6	26	307	838	1145	23.3	59	0	4.09		
92-4	5088	9,666,506	164	3.4	0	75	1.6	36	547	922	1469	30.4	89	1	5.80		
93-2	5051	4,798,791	76	3.2	0	27	1.1	6	42	316	358	14.9	49	1	5.34		
Babcock & Wilcox Idaho, Inc.																	
Production																	
91-4	454	862,706	44	10.2	0	35	8.1	4	23	275	298	69.1	9	0	12.99		
92-4	428	813,538	27	6.6	0	13	3.2	3	5	90	95	23.4	14	0	6.25		
93-2	368	350,008	9	5.1	0	4	2.3	3	13	28	41	23.4	5	0	5.51		
Westinghouse Idaho Nuclear Co.																	
Production																	
91-4	1961	3,726,580	63	3.4	1	32	1.7	13	93	142	235	12.6	30	0	10.85		
92-4	2108	4,005,770	49	2.4	0	24	1.2	11	150	143	293	14.6	25	0	3.64		
93-2	2097	1,992,579	22	2.2	0	12	1.2	2	7	56	63	6.3	10	0	2.89		

*Excluding NRE*

## INEL INJURY/ILLNESS EXPERIENCE BY CONTRACTOR

EQUIV.			T R C			L W C			* * LOST WORK DAYS * *			NON-FATAL TERMS			COST INDEX
YR.	FULL-TIME	HOURS	NO.	INCI-DENCE RATE	DEATHS	NO.	INCI-DENCE RATE	WITH AWAY	WDL	WDLR	NO.	INCI-DENCE RATE	CASES W/O LWD	OR PERM TRANS	
Idaho Field Office															
Government															
91-4	599	1,137,440	12	2.1	0	9	1.6	4	43	12	55	9.7	3	0	3.89
92-4	569	1,080,503	19	3.5	0	15	2.8	4	9	143	152	28.1	4	0	5.15
93-2	532	505,394	1	0.4	0	1	0.4	0	0	3	3	1.2	0	0	1.50
Argonne National Laboratory - West															
Research															
91-4	847	1,609,890	30	3.7	0	23	2.9	6	184	202	386	48.0	7	0	7.38
92-4	866	1,646,282	30	3.6	0	21	2.6	8	55	134	189	23.0	9	0	5.33
93-2	937	890,573	8	1.8	0	4	0.9	1	3	26	29	6.5	4	0	2.48
Argonne-West Subcontractors															
Lump Const															
91-4	25	47,507	0	0.0	0	0	0.0	0	0	0	0	0.0	0	0	0.99
92-4	35	65,880	1	3.0	0	1	3.0	1	1	0	1	3.0	0	0	5.09
93-2	87	82,267	0	0.0	0	0	0.0	0	0	0	0	0.0	0	0	0.99
Argonne-West Security Force															
Security															
91-4	48	90,827	3	6.6	0	3	6.6	1	1	50	51	112.3	0	0	10.85
92-4	54	102,281	2	3.9	0	2	3.9	1	4	4	8	15.6	0	0	6.76
93-2	60	56,760	0	0.0	0	0	0.0	0	0	0	0	0.0	0	0	0.99
Protection Technology - INEL															
Security															
91-4	550	1,045,850	36	6.9	0	22	4.2	15	332	180	512	97.9	14	1	23.26
92-4	505	959,370	25	5.2	0	17	3.5	16	173	1	174	36.3	8	0	9.45
93-2	567	538,864	3	1.1	0	3	1.1	3	14	0	14	5.2	0	0	2.91
EG&G Idaho, Inc.															
Research															
91-4	5176	9,834,402	136	2.8	0	77	1.6	26	307	838	1145	23.3	59	0	4.09
92-4	5088	9,666,506	164	3.4	0	75	1.6	36	547	922	1469	30.4	89	1	5.80
93-2	5051	4,798,791	76	3.2	0	27	1.1	6	42	316	358	14.9	49	1	5.34
Babcock & Wilcox Idaho, Inc.															
Production															
91-4	454	862,706	44	10.2	0	35	8.1	4	23	275	298	69.1	9	0	12.99
92-4	428	813,538	27	6.6	0	13	3.2	3	5	90	95	23.4	14	0	6.25
93-2	368	350,008	9	5.1	0	4	2.3	3	13	28	41	23.4	5	0	5.51
Westinghouse Idaho Nuclear Co.															
Production															
91-4	1961	3,726,580	63	3.4	1	32	1.7	13	93	142	235	12.6	30	0	10.85
92-4	2108	4,005,770	49	2.4	0	24	1.2	11	150	143	293	14.6	25	0	3.64
93-2	2097	1,992,579	22	2.2	0	12	1.2	2	7	56	63	6.3	10	0	2.89
Kaiser Engineering - ID															
Cost Const															
91-4	42	80,075	5	12.5	0	1	2.5	0	0	1	1	2.5	4	0	6.65
92-2	42	39,602	2	10.1	0	0	0.0	0	0	0	0	0.0	2	0	3.52
MK-Ferguson Company - ID															
Cost Const															
91-4	232	441,523	16	7.2	0	8	3.6	2	7	286	293	132.7	8	0	8.37
92-4	228	433,721	10	4.6	0	3	1.4	3	8	69	77	35.5	7	0	4.30
93-2	279	265,012	6	4.5	0	2	1.5	2	15	0	15	11.3	4	0	4.77
MK-Ferguson Subcontractors - ID															
Lump Const															
91-4	447	848,703	138	32.5	0	47	11.1	33	290	143	433	102.0	91	0	27.46
92-4	293	556,920	24	8.6	0	8	2.9	5	47	89	136	48.8	16	0	8.11
93-2	116	109,796	3	5.5	0	0	0.0	0	0	0	0	0.0	3	0	2.33

**LLNL 1988a**

UCRL-21045  
P. O. 9451705

**NATURAL PHENOMENA HAZARDS MODELING PROJECT:**

**PRELIMINARY FLOOD HAZARDS ESTIMATES  
FOR SCREENING  
DEPARTMENT OF ENERGY SITES:  
ALBUQUERQUE OPERATIONS OFFICE**

Prepared by

Martin W. McCann, Jr.  
Auguste C. Boissonnade

Prepared for

The Office of the Assistant Secretary for  
Environment, Safety and Health,  
Office of Nuclear Safety,  
United States Department of Energy

Under Contract to

Lawrence Livermore National Laboratory  
University of California  
Livermore, California

May 1988

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LLNL 1995g

This document was updated and has been provided to the reading room. See citation LLNL 1996g.

LLNL 1996i:1

## MEMORANDUM

Date: 02/07/96

Subject: Deep Borehole PEIS Data Report - additional data and clarifications

**Question 1:** Permission to use Table 1.3.3-1 from the Preliminary PEIS Input Data Report for the Deep Borehole Disposal Facility for Surplus Fissile Materials (UCRL-LR-119141-DR) in the FMDP PEIS.

**Answer 1:** Please use the modified Table given below.

**Table 1.3.3-1: Characteristics of Geologic Media Relevant to Plutonium Disposal in Deep Boreholes**

Medium Type	Advantages	Disadvantages
<b>Plutonic/Metamorphic "Basement" Rocks.</b> (e.g., granite)  <i>No disqualifiers, potential host rock.</i>	Salinity increases with depth, fewer fractures at depth, mechanically strong, impermeable matrix, occurs in sufficiently thick sections, many locations with large areal extent.	Limited data on conditions at depth, may be structurally complex.
<b>Tuffs</b> (consolidated volcanic ash)  <i>Not suitable due to tectonic instability and vertical discontinuity.</i>	High compressive strength; high sorptivity.	Columnar joints; fractures and cavities, water may induce geochemical changes, limited geologically old occurrences (fails tectonic stability test), vertical section discontinuous, may have insufficient depth.
<b>Rock Salt (evaporite)</b>  <i>Probably not suitable for borehole due to unfavorable mechanical properties.</i>	Isolated from aquifers; low interstitial water content; self-healing of fractures due to plasticity.	Interbedded rock layers in bedded salt could act as fluid conduits, brine pockets could migrate, drilling difficulties due to plasticity, holes may close before emplacement due to plastic flow, may not be thick enough, not as old as basement rock implying less stability, mobile salt (domes) are unstable.
<b>Anhydrite (evaporite)</b>  <i>Probably not suitable due to unfavorable mechanical properties.</i>	Chemically stable; little interstitial water; hydration induced swelling may reduce permeability.	Brittle and easily fractured; not self healing, massive swelling during hydration causes fractures and borehole instability, may not be thick enough, not as old as basement rocks implying less stability, limited areal extent.



NOAA 1994a

NOAA 1994a

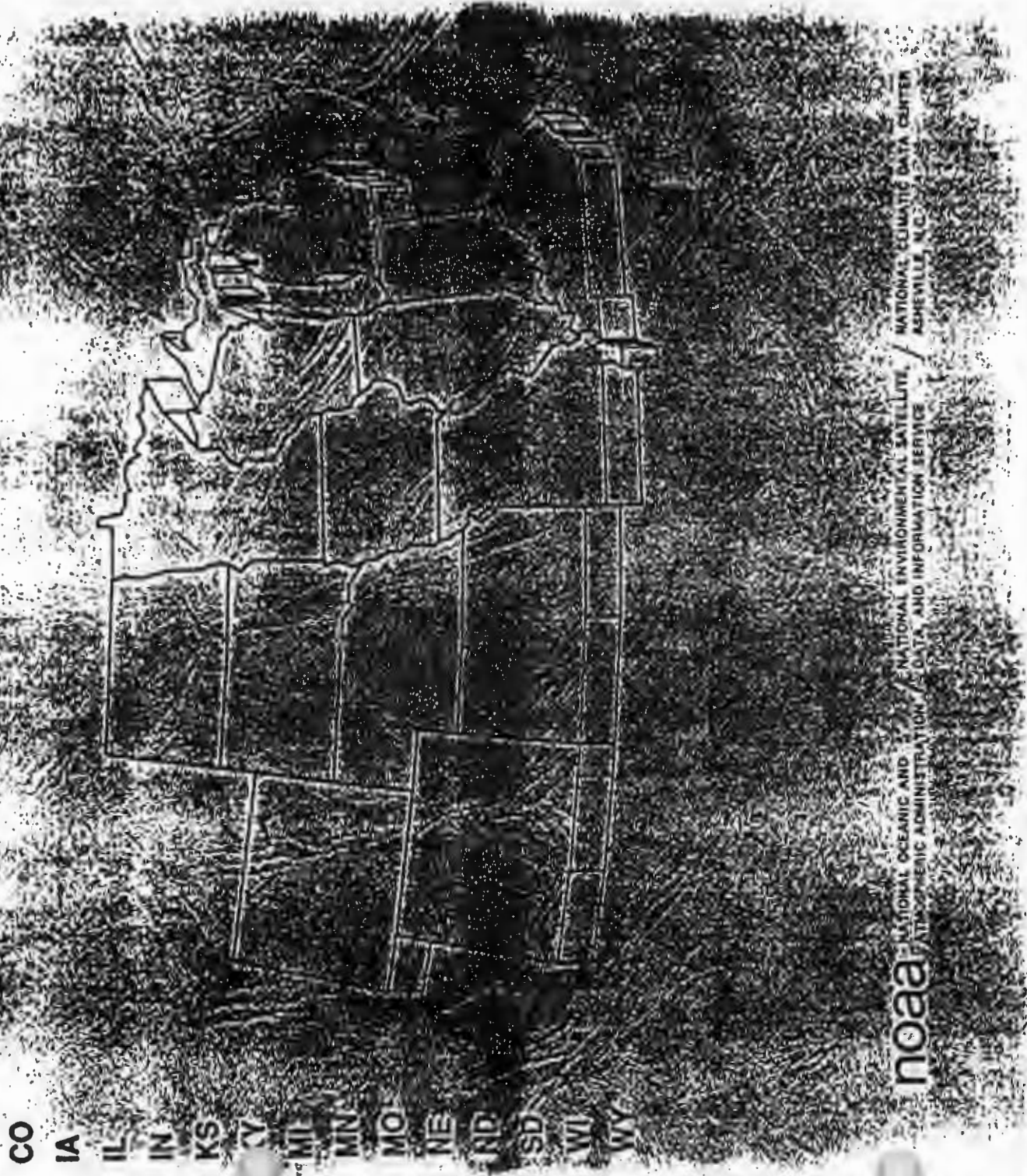


# LOCAL CLIMATOLOGICAL DATA

## ANNUAL SUMMARIES FOR 1993

### PART III CENTRAL REGION

CO  
IA  
IL  
IN  
KS  
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MI  
MN  
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NE  
ND  
SD  
WI  
WY



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NATIONAL CLIMATIC DATA CENTER  
ASHEVILLE, N.C.

**LOCAL CLIMATOLOGICAL DATA**  
**PUBLISHED STATIONS**  
 (Monthly and Annual)  
 APRIL 1994

NATIONAL CLIMATIC DATA CENTER  
 ROOM 120  
 151 PATTON AVENUE  
 ASHEVILLE, NORTH CAROLINA 28801-5001

<b>ALABAMA</b>	<b>FLORIDA</b>	<b>MASSACHUSETTS</b>	<b>NEW YORK</b>	<b>SOUTH DAKOTA</b>
— BIRMINGHAM AP	* — APALACHICOLA	— BOSTON	— ALBANY	— ABERDEEN
— HUNTSVILLE	— DAYTONA BEACH	A — BLUE HILL OBS.	— BINGHAMTON	— HURON
— MOBILE	— FORT MYERS	— WORCESTER	— BUFFALO	— RAPID CITY
— MONTGOMERY	— GAINESVILLE	<b>MICHIGAN</b>	— ISLIP	— SIOUX FALLS
<b>ALASKA</b>	— JACKSONVILLE	— ALPENA	A — NY CENTRAL PARK	<b>TENNESSEE</b>
— ANCHORAGE	— KEY WEST	— DETROIT	— NY JF KENNEDY IAP	— BRISTOL
— ANNETTE	— MIAMI	— FLINT	— NY LAGRADIA FIELD	— CHATTANOOGA
— BARROW	— ORLANDO	— GRAND RAPIDS	— ROCHESTER	— KNOXVILLE
— BETHEL	— PENSACOLA	— HOUGHTON LAKE	— SYRACUSE	— MEMPHIS
— BETTLES	— TALLAHASSEE	— LANSING	<b>NORTH CAROLINA</b>	— NASHVILLE
— BIG DELTA	— TAMPA	A — MARQUETTE	— ASHEVILLE	A — OAK RIDGE
— COLD BAY	— VERO BEACH	— MUSKOGON	— CAPE HATTERAS	<b>TEXAS</b>
— FAIRBANKS	— WEST PALM BEACH	— SAULT STE. MARIE	— CHARLOTTE	— ABILENE
— GULICANA	<b>GEORGIA</b>	<b>MINNESOTA</b>	— GREENSBORO	— AMARILLO
— HOMER	— ATHENS	— DULUTH	— RALEIGH	— AUSTIN
— JUNEAU	— ATLANTA	— INTERNATIONAL FALLS	— WILMINGTON	— BROWNSVILLE
— KING SALMON	— AUGUSTA	— MINNEAPOLIS-ST. PAUL	<b>NORTH DAKOTA</b>	— CORPUS CHRISTI
— KODIAK	— COLUMBUS	— ROCHESTER	— BISMARCK	— DALLAS-FORT WORTH
— KOTZEBUE	— MACON	— ST. CLOUD	— FARGO	A — DEL RIO
— MCGRATH	— SAVANNAH	<b>MISSISSIPPI</b>	— WILLISTON	A — EL PASO
— NOME	<b>HAWAII</b>	— JACKSON	<b>OHIO</b>	A — GALVESTON
— ST. PAUL ISLAND	— HILO	— MERIDIAN	— AKRON-CANTON	— HOUSTON
— TAIKEETHA	— HONOLULU	— TUPELO	— CINCINNATI AP	— LUBBOCK
B — UNALAKLEET	— KAHALUI	<b>MISSOURI</b>	— CLEVELAND	— MIDLAND
— VALDEZ	— LIHUE	— COLUMBIA	— COLUMBUS	— PORT ARTHUR
— YAKUTAT	<b>IDaho</b>	— KANSAS CITY INT'L AP	— DAYTON	— SAN ANGELO
<b>ARIZONA</b>	— BOISE	— ST. LOUIS	— HANSFIELD	— SAN ANTONIO
— FLAGSTAFF	— LEVISTON	— SPRINGFIELD	— TOLEDO	— VICTORIA
— PHOENIX	— POCATELLO	<b>MONTANA</b>	— YOUNGSTOWN	— WACO
— TUCSON	<b>ILLINOIS</b>	— BILLINGS	<b>OKLAHOMA</b>	— WICHITA FALLS
A — WINSLOW	— CHICAGO O'HARE AP	— GLASGOW	— OKLAHOMA CITY	<b>UTAH</b>
A — YUMA	— HOLME	— GREAT FALLS	— TULSA	— SALT LAKE CITY
<b>ARKANSAS</b>	— PEORIA	* — HAYRE	<b>OREGON</b>	<b>VERMONT</b>
— FORT SMITH	— ROCKFORD	— HELENA	— ASTORIA	— BURLINGTON
— LITTLE ROCK AP	— SPRINGFIELD	— KALISPELL	— BURNS	<b>VIRGINIA</b>
A — NO. LITTLE ROCK	<b>INDIANA</b>	— MISSOULA	— EUGENE	— LYNCHBURG
<b>CALIFORNIA</b>	— EVANSVILLE	<b>NEBRASKA</b>	— MEDFORD	— NORFOLK
— BAKERSFIELD	— FORT WAYNE	— GRAND ISLAND	— PENDLETON	— RICHMOND
— BISHOP	— INDIANAPOLIS	— LINCOLN	— PORTLAND	— ROANOKE
A — EUREKA	— SOUTH BEND	— NORFOLK	— SALEM	B — WALLOPS ISLAND
— FRESNO	<b>IOWA</b>	— NORTH PLATTE	<b>PACIFIC ISLANDS</b>	<b>WASHINGTON</b>
— LONG BEACH	— DES MOINES	— OMAHA EPPELEY AP	— CHUK (TRUK)	— OLYMPIA
A — LOS ANGELES AP	— DUBUQUE	* — OMAHA (NORTH)	— GUAM	— QUILLAYUTE
— LOS ANGELES CO	— SIOUX CITY	— SCOTTSBLUFF	— JOHNSTON	— SEATTLE-TACOMA AP
— REDDING	— WATERLOO	— VALENTINE	— KOROR	A — SEATTLE CO
— SACRAMENTO	<b>KANSAS</b>	<b>NEVADA</b>	— KWAJALEIN	— SPOKANE
— SAN DIEGO	— CONCORDIA	— ELKO	— MAJURO	*A — WALLA WALLA
— SAN FRANCISCO AP	— DODGE CITY	— ELY	— PAGO PAGO	— YAKIMA
A — SAN FRANCISCO CO	— GOODLAND	— LAS VEGAS	— PONAPEI	<b>WEST INDIES</b>
— SANTA BARBARA	— TOPEKA	— RENO	— WAKE	— SAN JUAN, P.R.
— SANTA MARIA	— WICHITA	— WINHEMUCCA	— YAP	<b>WEST VIRGINIA</b>
— STOCKTON	<b>KENTUCKY</b>	<b>NEW HAMPSHIRE</b>	<b>PENNSYLVANIA</b>	— BECKLEY
<b>COLORADO</b>	— JACKSON	— CONCORD	— ALLENTOWN	— CHARLESTON
— ALAMOSA	— LEXINGTON	A — MT. WASHINGTON	— AVOCA, WILKES-	— ELKINS
— COLORADO SPRINGS	— LOUISVILLE	<b>NEW JERSEY</b>	— BARRE, SCRANTON AP	— HUNTINGTON
— DENVER	— PADUCAH	— ATLANTIC CITY AP	* — HARRISBURG	<b>WISCONSIN</b>
— GRAND JUNCTION	<b>LOUISIANA</b>	A — ATL. CITY ST MARINA	* — MIDDLETOWN	— GREEN BAY
— PUEBLO	— BATON ROUGE	— NEWARK	— PHILADELPHIA	— LA CROSSE
<b>CONNECTICUT</b>	— LAKE CHARLES	<b>NEW MEXICO</b>	— PITTSBURGH	— MADISON
— BRIDGEPORT	— NEW ORLEANS	— ALBUQUERQUE	— WILLIAMSPORT	— MILWAUKEE
— HARTFORD	— SHREVEPORT	* — CLAYTON	<b>RHODE ISLAND</b>	<b>WYOMING</b>
<b>DELAWARE</b>	<b>MAINE</b>	— ROSWELL	*A — BLOCK ISLAND	— CASPER
— WILMINGTON	— CARIBOU	<b>MASSACHUSETTS</b>	— PROVIDENCE	— CHEYENNE
<b>DISTRICT OF COLUMBIA</b>	— PORTLAND	— BOSTON	<b>SOUTH CAROLINA</b>	— LANDER
— WASHINGTON-NATL AP	<b>MARYLAND</b>	— WORCESTER	— CHARLESTON AP	— SHERIDAN
— WASHINGTON-DULLES IAP	— BALTIMORE	— BLUE HILL OBS.	— CHARLESTON CO	
		— WORCESTER	— COLUMBIA	
			— GREENVILLE-SPARTANBURG	

AP = AIRPORT  
 CO = CITY OFFICE

\* SEE PUBLICATION RECORD ON REVERSE.  
 A MONTHLY SUMMARY DOES NOT INCLUDE 3-HOURLY OBSERVATIONS.  
 B ANNUAL SUMMARY NOT ISSUED.

PUBLICATION RECORD AND SUBSCRIPTION INFORMATION ON REVERSE

993

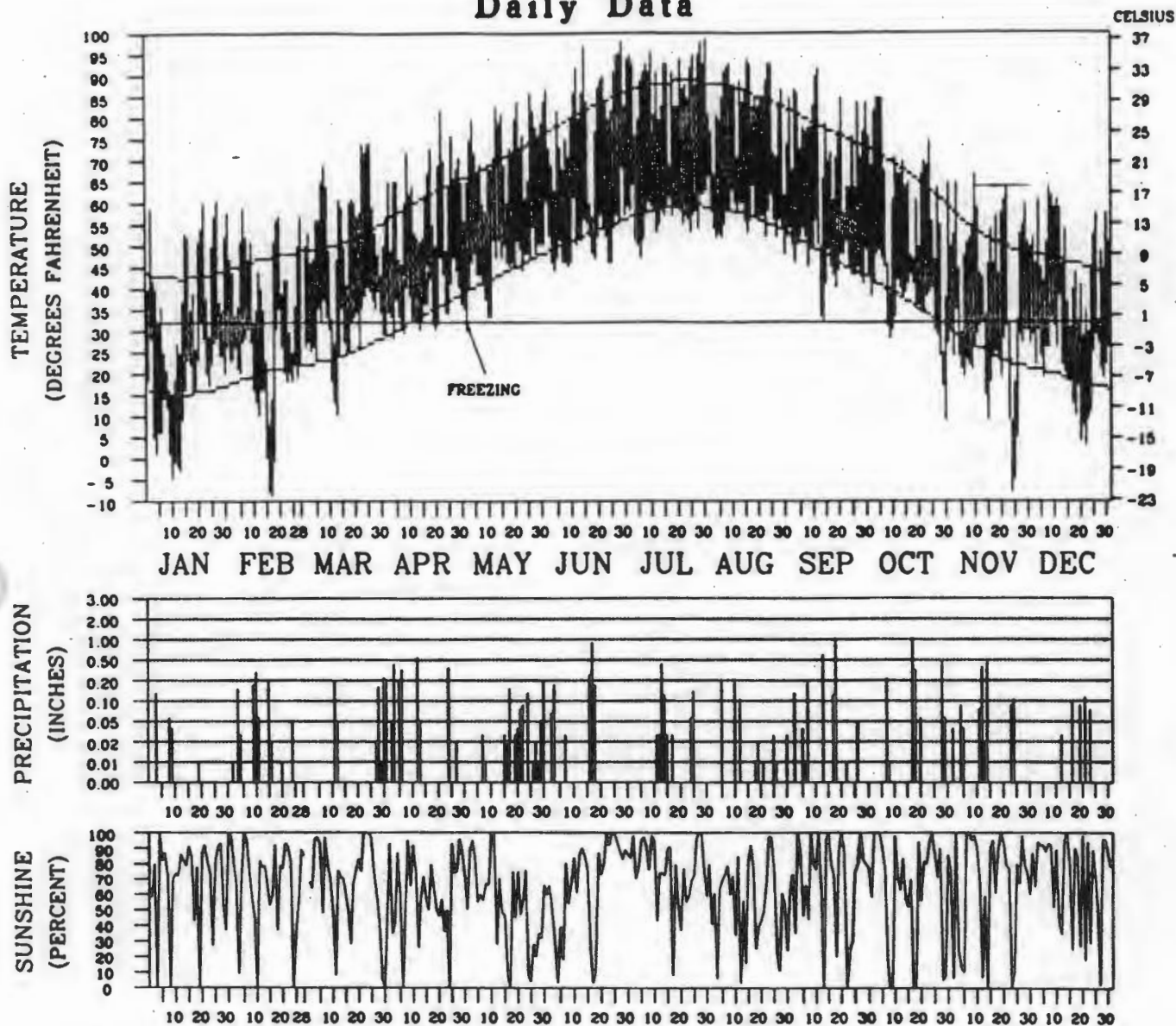
# LOCAL CLIMATOLOGICAL DATA

## ANNUAL SUMMARY WITH COMPARATIVE DATA

### DENVER, COLORADO



### Daily Data



TEMPERATURE DEPICTS NORMAL MAXIMUM, NORMAL MINIMUM AND ACTUAL DAILY HIGH AND LOW VALUES (FAHRENHEIT)  
 PRECIPITATION IS MEASURED IN INCHES. SCALE IS NON-LINEAR  
 SUNSHINE IS PERCENT OF THE POSSIBLE SUNSHINE

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER, ASHEVILLE, NORTH CAROLINA, 28801

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AND INFORMATION SERVICE

 NATIONAL  
CLIMATIC DATA CENTER  
ASHEVILLE NORTH CAROLINA

*Kenneth D. Nadeau*  
 DIRECTOR  
 NATIONAL CLIMATIC DATA CENTER

# METEOROLOGICAL DATA FOR 1993

DENVER, COLORADO

LATITUDE 39°45' N LONGITUDE 104°52' W ELEVATION: FT GRND 5282 BARO 5287 TIME ZONE: MOUNTAIN HBAN: 23062

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
<b>TEMPERATURE OF:</b>													
Averages													
-Daily Maximum	39.4	40.6	55.4	61.6	72.6	81.1	89.0	83.5	74.9	62.5	47.9	47.2	63.0
-Daily Minimum	15.2	18.1	29.7	35.4	45.0	51.7	57.0	56.5	46.3	35.8	21.5	21.1	36.1
-Monthly	27.3	29.4	42.6	48.5	58.8	66.4	73.0	70.0	60.6	49.2	34.7	34.2	49.6
-Monthly Dmpt	15.0	17.6	22.9	28.0	38.9	41.9	47.6	48.8	39.3	31.1	18.9	15.6	30.5
Extremes													
-Highest	61	59	74	82	86	98	99	94	92	85	67	64	99
-Date	27	6	26	22	26	29	31	16	12	6	10	8	JUL 31
-Lowest	-5	-9	10	28	30	44	47	48	32	9	-8	3	-9
-Date	10	17	13	4	2	4	6	30	14	30	24	22	FEB 17
<b>DEGREE DAYS BASE 65 °F:</b>													
Heating	1162	992	686	489	195	71	1	20	152	488	900	948	6104
Cooling	0	0	0	0	10	121	256	185	30	5	0	0	607
<b>% OF POSSIBLE SUNSHINE</b>													
	70	66	66	61	53	67	76	55	69	64	64	72	65
<b>AVG. SKY COVER (tenths)</b>													
Sunrise - Sunset	5.1	5.8	5.8	6.3	6.3	4.5	4.6	6.5	4.2	5.7	5.2	4.5	5.4
Midnight - Midnight	4.4	5.5	5.8	6.5	5.9	4.3	4.1	5.8	4.1	5.3	4.9	4.1	5.1
<b>NUMBER OF DAYS:</b>													
Sunrise to Sunset													
-Clear	11	8	5	6	6	15	9	6	14	11	10	14	115
-Partly Cloudy	11	10	14	11	13	8	18	11	9	7	9	8	129
-Cloudy	9	10	12	13	12	7	4	14	7	13	11	9	121
Precipitation													
0.1 inches or more	4	10	7	8	15	6	8	9	9	7	9	5	97
Snow, Ice pellets, hail													
1.0 inches or more	2	5	1	2	0	0	0	0	1	2	5	3	21
Thunderstorms	0	0	0	2	10	7	12	11	6	1	0	0	49
Heavy Fog, visibility													
1/4 mile or less	3	3	1	1	0	0	0	1	0	0	1	0	10
<b>Temperature of</b>													
-Maximum													
90° and above	0	0	0	0	0	7	18	7	2	0	0	0	34
32° and below	10	6	1	0	0	0	0	0	0	1	4	4	26
-Minimum													
32° and below	31	27	17	12	1	0	0	0	1	9	29	29	156
0° and below	4	4	0	0	0	0	0	0	0	0	2	0	10
<b>AVG. STATION PRESS. (mb)</b>													
	834.4	834.4	835.9	832.7	835.8	834.4	835.8	839.5	838.8	838.5	835.8	835.4	835.9
<b>RELATIVE HUMIDITY (%)</b>													
Hour 05	76	80	68	72	78	69	74	75	74	74	72	61	73
Hour 11	54	52	41	37	38	33	34	39	41	43	44	36	41
Hour 17 (Local Time)	64	58	40	40	40	33	30	39	38	44	55	49	44
Hour 23	74	77	64	63	66	57	54	61	63	67	70	58	65
<b>PRECIPITATION (inches):</b>													
Water Equivalent													
-Total	0.25	1.05	0.89	2.08	0.93	1.67	0.91	0.64	2.29	2.27	1.38	0.42	14.78
-Greatest (24 hrs)	0.14	0.44	0.24	0.62	0.21	1.02	0.58	0.22	1.21	1.33	0.53	0.12	1.33
-Date	3	9-10	30	12-13	30	17-18	13-14	10	17-18	17-18	13-14	21	OCT 17-18
Snow, Ice pellets, hail													
-Total	3.7	16.9	4.9	3.7	0.0	7	0.0	0.0	5.4	5.4	17.4	5.6	63.0
-Greatest (24 hrs)	1.8	5.0	3.4	1.9	0.0	7	0.0	0.0	5.4	5.4	6.0	2.3	6.0
-Date	8-9	9-10	11-12	12-13		7			13	28-29	13-14	21	NOV 13-14
<b>WIND:</b>													
Resultant													
-Direction (!!!)	167	050	036	015	105	123	136	159	149	095	144	253	108
-Speed (mph)	0.4	0.9	1.5	1.8	1.4	1.6	0.9	1.7	0.5	0.9	1.4	0.9	0.6
Average Speed (mph)	7.2	6.9	9.3	8.9	8.6	9.3	9.3	8.1	8.0	7.2	7.3	8.3	8.2
Fastest Obs. 1 Min.													
-Direction (!!!)	29	29	22	33	35	22	29	27	35	30	29	28	29
-Speed (mph)	39	32	35	46	37	31	46	28	35	32	26	35	46
-Date	22	21	26	18	14	21	8	21	7	10	26	31	JUL 8
Peak Gust													
-Direction (!!!)	W	W	SW	NW	NW	W	W	S	N	NW	W	W	W
-Speed (mph)	55	46	55	55	51	46	55	37	53	43	37	46	55
-Date	22	21		18	26	11	8	13	7	10	3	31	JUL 8

!!! See Reference Notes on Page 68  
Page 2

# NORMALS, MEANS, AND EXTREMES

DENVER, COLORADO

LATITUDE: 39°45' N LONGITUDE: 104°52' W ELEVATION: FT GRND 5282 BARO 5287 TIME ZONE MOUNTAIN MBAN 23062

		JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
<b>TEMPERATURE OF:</b>														
Normals		43.2	46.6	52.2	61.8	70.8	81.4	88.2	85.8	76.9	66.3	52.5	44.5	64.2
-Daily Maximum		16.1	20.2	25.8	34.5	43.6	52.4	58.6	56.9	47.6	36.4	25.4	17.4	36.2
-Daily Minimum		29.7	33.4	39.0	48.2	57.2	66.9	73.5	71.4	62.3	51.4	39.0	31.0	50.3
-Monthly														
Extremes														
-Record Highest	59	73	76	84	90	96	104	104	101	97	89	79	75	104
-Year		1982	1963	1971	1992	1942	1936	1939	1938	1960	1991	1990	1980	JUL 1939
-Record Lowest	59	-25	-30	-11	-2	22	30	43	41	17	3	-8	-25	-30
-Year		1963	1936	1943	1975	1954	1951	1972	1964	1985	1969	1993	1990	FEB 1936
<b>NORMAL DEGREE DAYS:</b>														
Heating (base 65°F)		1094	885	806	504	253	71	0	0	144	429	780	1054	6020
Cooling (base 65°F)		0	0	0	0	11	128	267	203	63	7	0	0	679
<b>% OF POSSIBLE SUNSHINE</b>														
	44	71	70	69	67	64	70	71	71	74	72	64	67	69
<b>MEAN SKY COVER (tenths)</b>														
Sunrise - Sunset	45	5.5	5.9	6.2	6.1	6.2	5.1	5.0	5.0	4.4	4.5	5.5	5.3	5.4
<b>MEAN NUMBER OF DAYS:</b>														
Sunrise to Sunset														
-Clear	59	10.3	8.0	7.8	6.7	6.1	9.6	9.2	9.7	13.4	13.3	10.1	10.9	115.2
-Partly Cloudy	59	9.3	8.7	10.1	10.7	12.2	12.2	15.6	13.7	9.0	9.1	9.6	9.6	129.7
-Cloudy	59	11.5	11.5	13.2	12.6	12.7	8.2	6.2	7.6	7.6	8.6	10.3	10.5	120.3
Precipitation														
.01 inches or more	59	5.8	5.9	8.6	8.5	10.8	8.7	9.3	8.8	6.3	5.3	5.6	5.3	89.1
Snow, ice pellets, hail														
1.0 inches or more	59	2.4	2.4	3.6	2.5	0.4	0.0	0.0	0.0	0.3	1.2	2.6	2.5	17.9
Thunderstorms	59	0.4	0.1	0.3	1.5	6.4	9.9	11.1	8.3	3.5	0.8	0.1	0.0	41.9
Heavy fog Visibility														
1/4 mile or less	53	1.1	1.6	1.1	0.8	0.5	0.4	0.4	0.6	0.6	0.6	1.2	1.1	9.9
<b>Temperature of</b>														
-Maximum														
90° and above	33	0.0	0.0	0.0	0.4	0.3	6.3	15.0	9.3	2.2	0.0	0.0	0.0	33.1
32° and below	33	6.5	4.3	2.8	0.4	0.0	0.0	0.0	0.0	0.4	0.4	2.5	5.3	22.2
-Minimum														
32° and below	33	29.8	26.0	24.3	11.4	1.5	0.0	0.0	0.0	0.8	8.6	24.4	29.2	156.1
0° and below	33	3.8	1.7	0.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.8	9.0
<b>AVG. STATION PRESS. (mb)</b>														
	21	834.7	834.7	832.3	833.5	834.4	836.4	838.8	839.1	838.5	837.8	835.3	834.9	835.8
<b>RELATIVE HUMIDITY (%)</b>														
Hour 05	33	64	67	68	67	71	69	69	70	69	65	68	65	68
Hour 11 (Local Time)	33	45	44	42	38	39	37	35	37	38	36	44	45	40
Hour 17	33	49	44	40	35	38	35	34	35	34	35	49	52	40
Hour 23	33	63	65	62	58	61	59	57	59	59	59	65	64	61
<b>PRECIPITATION (inches):</b>														
Water Equivalent														
-Normal		0.50	0.57	1.28	1.71	2.40	1.79	1.91	1.51	1.24	0.98	0.87	0.64	15.40
-Maximum Monthly	59	1.44	1.66	4.56	4.17	7.31	4.69	6.41	5.85	4.67	4.17	2.97	2.84	7.31
-Year		1948	1960	1983	1942	1957	1967	1965	1979	1961	1969	1946	1973	MAY 1957
-Minimum Monthly	59	0.01	0.01	0.13	0.03	0.06	0.09	0.17	0.06	1	0.05	0.01	0.03	1
-Year		1952	1970	1945	1963	1974	1980	1939	1960	1944	1962	1949	1977	SEP 1944
-Maximum in 24 hrs	59	1.02	1.01	2.79	3.25	3.55	3.16	2.42	3.43	2.44	1.71	1.29	2.00	3.55
-Year		1962	1953	1983	1967	1973	1970	1965	1951	1936	1947	1975	1982	MAY 1973
Snow, ice pellets, hail														
-Maximum Monthly	59	24.3	18.3	30.5	28.3	13.6	0.3	1	1	21.3	31.2	39.1	30.8	39.1
-Year		1992	1960	1983	1935	1950	1951	1992	1991	1936	1969	1946	1973	NOV 1946
-Maximum in 24 hrs	59	14.5	9.5	18.0	17.3	10.7	0.3	1	1	19.4	12.4	15.9	23.6	23.6
-Year		1992	1953	1983	1957	1950	1951	1992	1991	1936	1969	1983	1982	DEC 1982
<b>WIND:</b>														
Mean Speed (mph)	45	8.6	8.8	9.7	10.0	9.3	8.9	8.3	8.0	7.9	7.8	8.2	8.4	8.6
Prevailing Direction		S	S	S	S	S	S	S	S	S	S	S	S	S
through 1963														
Fastest Obs. 1 Min.														
-Direction (!!!)	12	32	30	30	33	36	21	29	33	29	01	36	32	33
-Speed (MPH)	12	44	36	41	46	43	38	46	33	36	36	36	38	46
-Year		1982	1989	1991	1993	1983	1987	1993	1989	1988	1992	1987	1981	APR 1993
Peak Gust														
-Direction (!!!)	10	W	NW	W	NW	SE	NW	W	NW	W	NW	W	W	NW
-Speed (mph)	10	55	52	59	62	60	60	55	52	56	48	49	51	62
-Date		1993	1990	1989	1986	1991	1988	1993	1989	1984	1990	1990	1990	APR 1986

## PRECIPITATION (inches)

## DENVER, COLORADO

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
1964	0.26	1.04	1.38	1.25	2.53	0.82	0.72	0.27	0.41	0.18	0.88	0.40	10.74
1965	1.00	1.27	1.20	1.05	1.82	4.14	6.41	1.06	2.58	0.45	0.36	0.53	21.87
1966	0.30	1.28	0.32	1.46	0.34	1.41	1.04	2.06	1.15	0.96	0.32	0.17	10.81
1967	0.84	0.39	0.79	3.95	4.77	4.69	3.25	0.83	0.60	1.13	1.01	1.06	23.31
1968	0.51	0.74	0.85	2.39	0.71	0.50	1.34	2.53	0.59	0.75	0.71	0.51	12.73
1969	0.17	0.43	1.10	1.33	6.12	2.99	1.81	0.79	1.67	4.17	0.62	0.32	21.52
1970	0.10	0.01	1.34	0.97	0.64	3.83	1.67	0.54	2.47	0.88	1.19	0.09	13.73
1971	0.35	0.78	0.53	1.98	1.34	0.23	1.20	0.85	2.85	0.44	0.16	0.25	10.96
1972	0.36	0.44	0.50	3.52	0.49	2.94	0.63	2.71	2.07	0.82	1.69	0.70	16.87
1973	1.31	0.16	1.76	3.73	5.06	0.20	2.47	1.28	2.85	0.47	0.83	2.84	22.96
1974	1.03	0.82	1.32	2.28	0.06	2.01	2.34	0.16	0.98	1.68	1.06	0.29	14.23
1975	0.23	0.37	1.19	1.14	2.80	2.11	2.78	2.00	0.24	0.30	1.88	0.47	15.51
1976	0.19	0.54	1.34	1.27	1.34	0.63	2.31	2.50	1.88	0.93	0.32	0.16	13.41
1977	0.16	0.27	1.24	2.13	0.34	1.02	2.98	1.00	0.10	0.48	0.59	0.03	10.34
1978	0.27	0.27	1.07	1.82	3.46	1.17	0.54	0.26	0.07	1.45	0.50	0.82	11.70
1979	0.34	0.42	1.25	1.41	3.53	2.39	0.81	5.85	0.36	1.28	1.66	1.06	20.36
1980	0.64	0.45	1.15	2.54	2.73	0.09	2.93	1.65	0.63	0.10	0.66	0.10	13.57
1981	0.29	0.35	2.27	1.01	3.76	0.63	0.90	1.16	0.35	0.79	0.42	0.66	12.59
1982	0.32	0.09	0.18	0.34	3.48	2.26	0.92	1.16	1.38	1.51	0.47	2.34	14.45
1983	0.15	0.07	4.56	2.10	3.62	2.65	1.75	1.51	0.13	0.39	2.63	0.63	20.19
1984	0.18	0.81	1.19	2.42	0.65	1.26	2.11	3.20	0.47	3.47	0.27	0.46	16.49
1985	0.68	0.59	0.69	2.61	1.33	1.46	3.71	0.28	2.33	0.77	1.20	0.66	16.31
1986	0.22	0.65	0.43	2.59	1.30	1.07	1.69	0.53	0.43	1.80	1.07	0.31	12.09
1987	0.69	1.21	1.34	1.03	4.64	3.50	0.76	2.00	0.70	1.24	1.62	1.30	20.03
1988	0.40	0.60	1.28	0.65	4.26	1.28	2.19	1.83	0.90	0.06	0.47	1.04	14.96
1989	1.14	0.66	0.56	1.00	3.83	2.04	1.64	1.28	1.55	0.81	0.15	0.81	15.47
1990	0.74	0.55	3.10	1.01	1.51	0.21	3.57	1.96	1.46	1.03	1.28	0.27	16.69
1991	0.76	0.08	0.76	1.94	2.43	2.20	4.11	3.69	0.79	0.70	2.67	0.19	20.32
1992	1.19	0.09	3.50	0.53	1.13	2.02	2.23	2.33	0.01	0.51	1.46	0.68	15.68
1993	0.25	1.05	0.89	2.08	0.93	1.67	0.91	0.64	2.29	2.27	1.38	0.42	14.78
Record													
Mean	0.48	0.57	1.16	1.95	2.41	1.51	1.74	1.45	1.09	1.02	0.72	0.63	14.72

See Reference Notes on Page 68.  
Page 4A

## AVERAGE TEMPERATURE (deg. F)

## DENVER, COLORADO

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
1964	30.6	27.4	33.0	46.6	58.8	65.0	75.8	70.4	62.5	52.7	40.0	33.2	49.7
1965	35.0	27.4	29.0	51.2	57.1	63.9	72.7	70.2	55.7	55.1	43.3	35.0	49.6
1966	28.6	28.4	42.5	44.6	58.7	64.6	76.9	70.8	65.0	52.2	41.5	31.9	50.5
1967	34.0	35.1	42.9	48.2	52.6	60.6	69.1	68.2	62.1	52.5	40.5	26.5	49.4
1968	29.7	34.2	40.6	43.0	53.9	67.8	71.7	68.1	60.9	51.9	35.7	28.9	48.9
1969	35.0	35.4	32.2	52.2	59.3	61.5	74.7	73.9	64.5	39.0	39.1	32.5	49.9
1970	30.6	38.6	33.5	43.7	58.8	65.2	72.0	73.9	59.5	45.9	39.1	33.3	49.5
1971	32.1	30.6	38.5	47.8	54.2	69.0	70.6	72.8	57.5	49.4	39.1	31.9	49.5
1972	30.5	36.2	44.8	48.5	57.0	68.3	70.2	71.0	62.1	52.1	32.9	24.9	49.9
1973	27.3	35.5	39.9	43.2	55.6	67.5	71.0	73.5	59.9	54.5	39.5	31.6	49.9
1974	23.7	35.2	43.2	47.9	61.6	68.4	74.7	69.5	59.4	52.4	38.0	31.2	50.5
1975	31.7	30.6	37.3	44.1	54.3	64.3	72.7	70.8	59.5	53.2	36.8	37.5	49.4
1976	32.3	39.3	37.1	49.2	56.7	66.3	75.3	70.2	61.8	48.4	39.5	35.5	51.0
1977	29.2	38.0	39.9	51.1	60.7	71.9	74.3	70.2	66.6	53.3	40.3	35.1	52.5
1978	25.8	31.4	43.3	50.3	54.4	66.9	74.7	69.6	65.0	53.1	37.8	24.6	49.7
1979	18.0	34.2	40.5	49.1	54.8	65.8	73.7	69.5	66.3	53.8	33.3	34.5	49.5
1980	26.0	34.5	38.0	47.7	57.1	71.9	76.4	73.2	65.8	52.4	41.9	41.2	52.2
1981	37.3	36.2	41.2	56.4	57.1	70.4	75.9	72.0	68.2	52.6	45.9	35.8	54.1
1982	30.3	32.0	41.1	47.4	55.1	63.1	72.7	73.1	61.7	49.0	35.7	30.9	49.3
1983	31.9	36.6	36.2	41.0	51.4	62.8	73.3	74.4	64.9	52.7	37.0	17.5	48.3
1984	27.3	34.1	37.2	42.3	60.0	66.5	74.9	71.8	60.7	44.8	39.7	32.8	49.3
1985	25.6	27.7	40.8	51.0	60.0	68.0	73.0	72.4	58.8	50.7	29.8	29.4	48.9
1986	40.3	36.1	47.1	49.6	56.7	70.3	73.5	72.2	60.7	49.3	39.0	31.0	52.2
1987	32.2	36.1	38.8	51.9	59.7	69.2	74.4	70.7	62.4	51.7	40.0	28.4	51.3
1988	25.2	34.1	38.5	50.3	59.0	71.9	74.2	73.6	62.3	54.0	40.6	31.1	51.2
1989	33.5	22.4	43.3	51.1	59.0	65.4	75.9	71.7	62.5	51.3	42.8	27.3	50.5
1990	36.4	33.3	39.5	49.1	56.6	72.6	70.8	71.3	66.9	52.3	44.0	25.7	51.5
1991	27.9	40.3	42.8	47.8	60.3	69.4	73.1	71.5	62.5	50.3	34.7	33.1	51.1
1992	31.8	40.1	43.0	54.8	60.6	66.1	70.5	68.4	65.2	53.7	33.9	25.4	51.1
1993	27.3	29.4	42.6	48.5	58.8	66.4	73.0	70.0	60.6	49.2	34.7	34.2	49.6
Record													
Mean	30.1	33.0	38.9	47.7	56.8	66.8	72.8	71.3	62.8	51.5	39.4	32.1	50.3
Max	42.8	45.4	51.5	60.5	69.6	80.7	86.7	85.0	77.0	65.5	52.4	44.8	63.5
Min	17.4	20.5	26.3	34.9	44.1	52.9	58.9	57.6	48.5	37.5	26.4	19.4	37.0

See Reference Notes on Page 68.  
Page 4B

## HEATING DEGREE DAYS Base 65 deg. F

DENVER, COLORADO

SEASON	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
1964-65	0	16	123	375	743	981	921	1044	1108	411	245	63	6030
1965-66	6	7	296	302	645	924	1122	1017	691	411	204	82	5900
1966-67	6	9	61	391	695	1018	954	832	679	498	388	135	5664
1967-68	4	16	108	389	729	1186	1086	885	751	655	343	138	6190
1968-69	10	35	145	399	871	1114	925	821	101	378	204	144	6057
1969-70	2	0	56	801	769	997	1061	734	969	632	200	78	6300
1970-71	24	0	198	584	770	977	1018	958	817	508	329	25	6184
1971-72	24	0	273	479	771	1019	1063	832	621	486	246	56	5818
1972-73	42	15	107	397	960	1239	1162	820	771	646	290	56	6505
1973-74	8	10	166	321	758	1029	1277	831	671	507	137	67	5772
1974-75	0	9	199	381	803	1043	1024	957	852	621	332	85	6306
1975-76	0	4	199	363	840	843	11006	749	859	469	252	64	6207
1976-77	0	7	142	509	759	907	11005	749	771	414	252	0	5500
1977-78	20	14	38	358	737	920	1206	854	665	473	313	81	5573
1978-79	20	20	96	366	811	1245	1450	854	751	435	313	81	6460
1979-80	0	20	58	347	941	939	1204	876	828	514	247	9	5983
1980-81	0	24	56	363	683	731	853	801	727	260	243	26	4770
1981-82	0	12	19	375	570	898	1071	918	733	322	306	22	5516
1982-83	3	0	151	487	875	1050	1017	789	885	712	419	129	5517
1983-84	3	1	87	372	833	1469	1163	889	854	673	183	51	6517
1984-85	0	1	183	622	753	990	1215	1041	742	412	167	42	6168
1985-86	0	1	241	435	1051	1094	1215	802	548	456	260	22	6168
1986-87	0	0	145	477	775	1045	1012	803	805	392	215	22	5668
1987-88	1	21	110	410	743	1125	969	869	811	432	213	14	5646
1988-89	7	0	129	333	723	1043	969	1193	665	432	213	76	5783
1989-90	0	0	153	424	658	1162	879	882	781	469	265	7	5680
1990-91	12	3	64	388	902	1211	1143	684	682	510	174	16	5510
1991-92	16	4	118	449	902	982	1022	714	673	309	158	35	5372
1992-93	10	35	158	446	926	1219	1162	992	686	489	195	71	5372
1993-94	1	20	152	488	900	948	1162	992	686	489	195	71	6189

See Reference Notes on Page 6B.

## COOLING DEGREE DAYS Base 65 deg. F

DENVER, COLORADO

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL
1969	0	0	0	0	35	44	312	284	46	0	0	0	721
1970	0	0	0	0	16	93	222	284	40	0	0	0	653
1971	0	0	0	0	6	149	203	248	53	1	0	0	562
1972	0	0	0	0	2	138	199	270	21	0	0	0	531
1973	0	0	0	0	36	176	307	157	39	0	0	0	715
1974	0	0	0	0	33	112	246	192	39	0	0	0	554
1975	0	0	0	0	33	112	297	176	53	0	0	0	667
1976	0	0	0	0	11	214	308	182	103	0	0	0	769
1977	0	0	0	0	12	152	308	171	103	0	0	0	748
1978	0	0	0	0	11	112	275	163	102	0	0	0	661
1979	0	0	0	0	2	112	358	263	121	0	0	0	946
1980	0	0	0	0	10	224	247	236	91	0	0	0	912
1981	0	0	0	0	6	42	264	301	91	0	0	0	611
1982	0	0	0	0	7	69	315	218	60	0	0	0	732
1983	0	0	0	0	33	137	256	238	50	0	0	0	730
1984	0	0	0	0	19	104	315	218	60	0	0	0	714
1985	0	0	0	0	11	188	271	227	55	0	0	0	717
1986	0	0	0	0	12	153	309	205	55	0	0	0	720
1987	0	0	0	0	35	225	300	277	55	0	0	0	893
1988	0	0	0	0	34	96	345	214	83	0	0	0	796
1989	0	0	0	0	34	244	196	203	129	0	0	0	782
1990	0	0	0	0	39	156	267	211	150	0	0	0	720
1991	0	0	0	0	29	176	187	148	30	0	0	0	524
1992	0	0	0	0	10	121	256	185	30	0	0	0	527
1993	0	0	0	0	10	121	256	185	30	0	0	0	527

See Reference Notes on Page 6B.

## SNOWFALL (inches)

## DENVER, COLORADO

SEASON	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
1964-65	0.0	0.0	0.0	1.0	6.0	4.4	13.2	17.1	14.9	0.3	1.0	0.0	55.9
1965-66	0.0	0.0	5.5	0.0	5.5	5.6	3.6	14.6	2.8	6.4	2.9	0.0	46.9
1966-67	0.0	0.0	1.0	8.3	3.0	1.9	9.9	4.4	6.6	3.6	3.0	0.0	40.7
1967-68	0.0	0.0	0.0	1.7	9.4	13.1	3.0	7.3	9.2	15.1	1.0	0.0	58.8
1968-69	0.0	0.0	0.0	0.4	5.8	6.9	2.8	4.2	13.2	1.0	0.0	0.0	33.3
1969-70	0.0	0.0	0.0	31.2	5.1	3.1	0.9	0.3	20.5	4.7	1.0	0.0	65.8
1970-71	0.0	0.0	4.6	5.9	9.2	0.9	8.6	11.9	9.6	6.0	1.0	0.0	56.7
1971-72	0.0	0.0	17.2	3.1	1.4	8.4	10.9	9.1	7.1	17.2	0.0	0.0	74.4
1972-73	0.0	0.0	0.0	9.7	19.4	9.8	12.1	3.0	15.1	24.8	1.0	0.0	94.9
1973-74	0.0	0.0	0.0	2.3	9.3	30.8	8.2	10.3	12.8	17.8	0.0	1.0	91.5
1974-75	0.0	0.0	1.8	1.0	11.9	2.1	3.6	4.0	14.3	10.9	6.1	0.0	55.7
1975-76	0.0	0.0	0.0	2.7	15.2	7.3	3.2	6.4	18.7	1.2	0.0	0.0	54.7
1976-77	0.0	0.0	0.0	7.2	4.5	3.1	2.4	3.1	9.6	4.7	0.0	0.0	34.6
1977-78	0.0	0.0	0.0	3.3	4.1	0.7	5.5	6.2	8.6	4.6	13.5	0.0	46.5
1978-79	0.0	0.0	1.0	2.7	6.9	14.2	9.1	5.8	18.2	8.1	8.2	0.0	73.2
1979-80	0.0	0.0	0.0	2.7	22.3	16.5	12.3	9.6	12.1	10.0	1.0	0.0	85.5
1980-81	0.0	0.0	0.0	1.5	7.1	1.2	4.1	4.3	24.0	2.9	1.0	0.0	45.1
1981-82	0.0	0.0	0.0	2.8	3.3	9.9	4.8	1.8	2.1	2.0	1.0	0.0	26.7
1982-83	0.0	0.0	0.0	1.2	1.8	27.1	1.3	0.8	30.5	11.3	7.6	0.0	81.6
1983-84	0.0	0.0	1.0	1.0	29.3	11.5	3.4	7.9	12.0	16.8	1.0	0.0	80.9
1984-85	0.0	0.0	5.2	13.1	2.3	5.0	12.5	8.7	7.6	0.8	1.0	0.0	55.2
1985-86	0.0	0.0	8.7	1.9	17.0	10.3	2.4	6.2	2.6	14.0	0.0	0.0	63.1
1986-87	0.0	0.0	0.0	4.3	11.5	4.9	17.0	12.2	11.5	9.9	0.0	0.0	71.3
1987-88	0.0	0.0	0.0	1.0	11.2	21.5	5.8	7.0	13.5	2.0	1.3	0.0	62.3
1988-89	0.0	0.0	0.0	0.0	2.8	12.3	13.0	8.2	4.8	9.0	1.0	0.0	50.1
1989-90	0.0	0.0	2.8	7.8	1.6	11.8	8.4	7.0	21.9	3.6	0.1	0.0	64.5
1990-91	1.0	1.0	0.0	7.6	12.0	4.7	14.1	0.8	4.2	14.3	1.0	0.0	57.7
1991-92	1.0	1.0	0.0	7.3	29.6	1.9	24.3	0.3	15.6	0.0	0.0	0.0	79.0
1992-93	1.0	0.0	0.0	0.1	20.1	11.0	3.7	16.9	4.9	3.7	0.0	0.0	60.4
1993-94	0.0	0.0	5.4	5.4	17.4	5.6							
Record Mean	1.0	1.0	1.6	3.8	8.9	7.4	8.2	7.4	12.6	8.9	1.6	1.0	60.4

See Reference Notes on Page 6B.  
Page 6A

## REFERENCE NOTES

## DENVER, COLORADO

## GENERAL

T - TRACE AMOUNT.  
BLANK ENTRIES DENOTE MISSING/UNREPORTED DATA.  
# INDICATES A STATION OR INSTRUMENT RELOCATION.  
SEE STATION LOCATION TABLE ON PAGE 8.

## SPECIFIC

## PAGE 2

PH - INCLUDES LAST DAY OF PREVIOUS MONTH  
ASOS - AUTOMATED SURFACE OBSERVING SYSTEM IN OPERATION DURING THESE MONTHS.

## PAGE 3

1st - LENGTH OF RECORD IN YEARS, ALTHOUGH INDIVIDUAL MONTHS MAY BE MISSING.  
0.0 OR . - THE VALUE IS BETWEEN 0.0 AND 0.05.  
NORMALS - BASED ON THE 1961-1990 RECORD PERIOD.  
EXTREMES - DATES ARE THE MOST RECENT OCCURRENCE.  
WIND DIR. - NUMERALS SHOW TENS OF DEGREES CLOCKWISE FROM TRUE NORTH. "00" INDICATES CALM.  
RESULTANT DIRECTIONS ARE GIVEN TO WHOLE DEGREES.  
BOLD VALUES INDICATE EXTREME VALUES WHICH OCCURRED AFTER THE ASOS SYSTEM WAS COMMISSIONED.

## PAGE 4B

RECORD - PERIOD OF RECORD  
RECORD MEAN PRECIPITATION IS THE MEAN OF ALL DAILY PRECIPITATION AMOUNTS DURING THE PERIOD OF RECORD.  
RECORD MAXIMUM TEMPERATURE IS THE MEAN OF ALL DAILY MAXIMUM TEMPERATURES DURING THE PERIOD OF RECORD.  
RECORD MEAN TEMPERATURE IS THE SUM OF THE RECORD MAX AND RECORD MIN DIVIDED BY 2.  
AVERAGE TEMPERATURE IS THE SUM OF THE MEAN DAILY MAX AND MIN TEMPERATURE DIVIDED BY 2.

## EXCEPTIONS

## PAGE 3

1. FASTEST WINDS ARE THROUGH AUGUST 1981.  
PAGES 4A, 4B, 6A  
RECORD MEANS ARE THROUGH THE CURRENT YEAR, BEGINNING IN 1872 FOR TEMPERATURE, 1872 FOR PRECIPITATION, 1935 FOR SNOWFALL.

## DENVER, COLORADO

Denver enjoys the invigorating climate that prevails over much of the central Rocky Mountain region, without the extremely cold mornings of the high elevations during winter, or the hot afternoons of summer at lower altitudes. Extremely warm or cold weather in Denver is usually of short duration.

Situated a long distance from any moisture source, and separated from the Pacific Ocean by several high mountain barriers, Denver enjoys low relative humidity, light precipitation, and abundant sunshine.

Air masses from four different sources influence Denver weather. These include arctic air from Canada and Alaska, warm, moist air from the Gulf of Mexico, warm, dry air from Mexico and the southwestern deserts, and Pacific air modified by its passage over mountains to the west.

In winter, the high altitude and mountains to the west combine to moderate temperatures in Denver. Invasions of cold air from the north, intensified by the high altitude, can be abrupt and severe. However, many of the cold air masses that spread southward out of Canada never reach the altitude of Denver, but move off over the lower plains to the east. Surges of air from the west are moderated in their descent down the east face of the Rockies, and reach Denver in the form of chinook winds that often raise temperatures into the 60s, even in midwinter.

In spring, polar air often collides with warm, moist air from the Gulf of Mexico and these collisions result in frequent, rapid and drastic weather changes. Spring is the cloudiest, windiest, and wettest season in the city. Much of the precipitation falls as snow, especially in March and early April. Stormy periods are interspersed with stretches of mild, sunny weather that quickly melt previous snow cover.

Summer precipitation falls mainly from scattered thunderstorms during the afternoon and evening. Mornings are usually clear and sunny, with clouds forming during early afternoon to cut off the sunshine at what would otherwise be the hottest part of the day. Severe thunderstorms, with large hail and heavy rain occasionally occur in the city, but these conditions are more common on the plains to the east.

Autumn is the most pleasant season. Few thunderstorms occur and invasions of cold air are infrequent. As a result, there is more sunshine and less severe weather than at any other time of the year.

Based on the 1951-1980 period, the average first occurrence of 32 degrees Fahrenheit in the fall is October 8 and the average last occurrence in the spring is May 3.

### Notice of Correction

Any previously received edition of the "Local Climatological Data Annual Summary for 1993" should be discarded. This revised edition contains updates to the "Normals" based upon the 1961-1990 record period as noted in the "Reference Notes" on Page 6B.

## STATION LOCATION

DENVER, COLORADO

LOCATION	OCCUPIED FROM	OCCUPIED TO	AIRLINE DISTANCES AND DIRECTIONS FROM PREVIOUS LOCATION	NORTH	WEST	ELEVATION ABOVE										REMARKS	
						SEA LEVEL	GROUND										
							GROUND	1-									

SUBSCRIPTION: Price and ordering information available through: National Climatic Data Center, Federal Building, Asheville, North Carolina 28801.  
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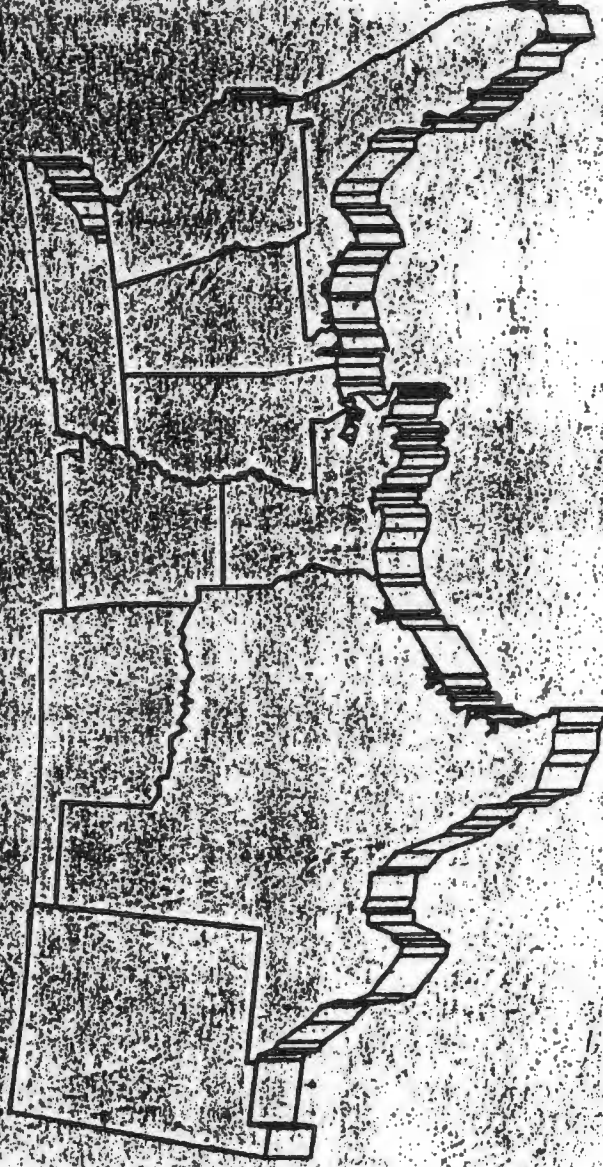


# LOCAL CLIMATOLOGICAL DATA

## ANNUAL SUMMARIES FOR 1993

### PART II - SOUTHERN REGION

AL AR FL GA LA MS NM OK PR TN TX



PUERTO RICO

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noaa

NATIONAL OCEANIC AND  
ATMOSPHERIC ADMINISTRATION

/ NATIONAL ENVIRONMENTAL SATELLITE,  
DATA, AND INFORMATION SERVICE

/ NATIONAL CLIMATIC DATA CENTER  
ASHEVILLE, N.C.

## Daily Data

Kenneth D Haden  
DIRECTOR  
NATIONAL CLIMATIC DATA CENTER

# METEOROLOGICAL DATA FOR 1993

BRISTOL, JOHNSON CITY, KINGSPORT, TENNESSEE

LATITUDE: 36°29' N LONGITUDE: 82°24' W ELEVATION: FT. GRND 1507 BARO 1558 TIME ZONE: EASTERN MBAN: 13877

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
<b>TEMPERATURE °F:</b>													
Averages													
-Daily Maximum	51.1	48.0	53.0	66.2	76.5	84.9	91.5	84.5	78.9	68.1	58.7	46.5	67.3
-Daily Minimum	32.3	26.7	34.2	40.2	52.9	60.5	67.7	63.1	55.3	42.4	34.9	30.1	45.0
-Monthly	41.7	37.4	43.6	53.2	64.7	72.7	79.6	73.8	67.1	55.3	46.8	38.3	56.2
-Monthly Dmpt.	32.3	24.2	33.1	37.5	53.8	60.7	66.1	65.5	58.0	45.0	36.2	28.9	45.1
Extremes													
-Highest	68	65	73	81	83	91	97	90	90	84	81	60	97
-Date	4	11	30	14	30	24	8	25	3	20	14	2	JUL 8
-Lowest	17	10	1	30	39	46	55	54	35	28	22	16	1
-Date	30	19	15	23	21	2	31	1	30	29	29	26	MAR 15
<b>DEGREE DAYS BASE 65 °F:</b>													
Heating	714	767	657	346	65	10	0	0	59	298	537	823	4276
Cooling	0	0	0	1	62	250	460	281	131	6	0	0	1191
<b>% OF POSSIBLE SUNSHINE</b>													
<b>AVG. SKY COVER (tenths)</b>													
Sunrise - Sunset	7.4	5.8	8.1	6.9	6.2	6.0	4.8	5.4	5.5	6.4	6.3	7.8	6.4
Midnight - Midnight	6.7	5.5	8.0	6.4	5.9	6.0	4.7	5.3	5.1	5.8	6.0	7.5	6.1
<b>NUMBER OF DAYS:</b>													
Sunrise to Sunset													
-Clear	5	10	2	5	5	6	9	11	10	7	7	3	80
-Partly Cloudy	5	5	9	9	17	16	16	12	9	11	9	6	124
-Cloudy	21	13	20	16	9	8	6	8	11	13	14	22	161
Precipitation													
.01 inches or more	10	10	19	9	11	8	8	8	11	12	11	15	132
Snow, Ice pellets, hail													
1.0 inches or more	0	2	2	0	0	0	0	0	0	1	0	0	5
Thunderstorms	0	1	3	0	6	3	10	7	3	0	0	0	33
Heavy Fog, visibility													
1/4 mile or less	2	0	5	2	5	1	6	7	8	5	2	1	44
Temperature of													
-Maximum													
90° and above	0	0	0	0	0	7	25	1	2	0	0	0	35
32° and below	0	1	2	0	0	0	0	0	0	0	0	1	4
-Minimum													
32° and below	15	23	12	1	0	0	0	0	0	5	15	18	89
0° and below	0	0	0	0	0	0	0	0	0	0	0	0	0
<b>AVG. STATION PRESS. (mb)</b>	966.5	963.4	961.7	960.2	962.1	963.8	963.8	964.3	964.1	963.8	966.6	962.8	963.6
<b>RELATIVE HUMIDITY (%)</b>													
Hour 01	79	72	82	69	85	87	85	95	91	89	84	79	83
Hour 07	83	78	83	79	89	87	89	96	95	93	87	83	87
Hour 13 (Local Time)	60	52	56	45	55	52	48	61	56	53	51	63	54
Hour 19	67	57	67	48	60	58	55	73	68	67	64	70	63
<b>PRECIPITATION (inches):</b>													
Water Equivalent													
-Total	3.21	2.12	5.51	2.43	3.42	0.98	4.59	5.01	2.50	2.19	3.58	5.85	41.39
-Greatest (24 hrs)	0.87	0.96	1.36	0.66	1.48	0.39	1.13	1.47	0.83	0.58	2.06	2.77	2.77
-Date	21	21	3-4	5-6	18-19	26	15	25-26	26-27	29-30	26-27	4-5	DEC 4-5
Snow, Ice pellets, hail													
-Total	T	2.3	14.2	T	0.0	T	0.0	0.0	0.0	1.3	T	1.9	19.7
-Greatest (24 hrs)	T	1.3	14.2	T	0.0	T	0.0	0.0	0.0	1.3	T	0.8	14.2
-Date	19	25	12-13	2		4				31	1	21	MAR 12-13
<b>WIND:</b>													
Resultant													
-Direction (!!!)	250	278	283	255	232	274	283	293	263	304	251	265	268
-Speed (mph)	0.6	3.0	2.1	2.6	0.8	1.2	1.4	0.3	1.6	0.6	1.2	2.3	1.4
Average Speed (mph)	6.1	6.9	7.1	7.0	4.8	4.4	4.2	3.7	4.7	4.8	4.6	6.0	5.4
Fastest Obs. 1 Min.													
-Direction (!!!)	24	26	26	34	32	31	34	30	27	25	29	26	30
-Speed (mph)	25	32	29	22	25	25	28	32	22	18	29	24	32
-Date	31	16	10	26	29	4	26	20	27	9	14	25	AUG 20
Peak Gust													
-Direction (!!!)	W	W	W	W	NW			S	W	W	NW	W	
-Speed (mph)	41	44	45	35	37			48	33	25	45	36	
-Date	13	16	10	20	29			26	27	9	14	25	

(!!!) See Reference Notes on Page 68

# NORMALS, MEANS, AND EXTREMES

BRISTOL, JOHNSON CITY, KINGSPORT, TENNESSEE

LATITUDE: 36°29'N		LONGITUDE: 82°24'W		ELEVATION: FT GRND		1507 BARO		1558		TIME ZONE: EASTERN		WBAN: 13877		
	(a)	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F:														
Normals														
-Daily Maximum		43.7	48.0	58.9	67.4	75.2	82.2	84.6	84.1	79.1	69.1	58.2	48.1	66.6
-Daily Minimum		24.3	26.8	35.4	43.0	51.6	59.9	64.1	63.1	56.6	44.2	35.9	28.2	44.4
-Monthly		34.0	37.4	47.2	55.2	63.4	71.1	74.4	73.6	67.9	56.7	47.0	38.2	55.5
Extremes														
-Record Highest	48	79	80	85	89	92	97	102	101	100	90	81	78	102
-Year		1950	1977	1954	1986	1969	1952	1952	1988	1954	1954	1993	1951	JUL 1952
-Record Lowest	48	-21	-5	-2	21	30	38	45	43	34	20	5	-9	-21
-Year		1985	1958	1980	1982	1989	1966	1947	1986	1983	1962	1950	1962	JAN 1985
NORMAL DEGREE DAYS:														
Heating (base 65°F)		961	773	552	298	121	6	0	0	44	280	540	831	4406
Cooling (base 65°F)		0	0	0	0	71	189	291	267	131	23	0	0	972
% OF POSSIBLE SUNSHINE														
MEAN SKY COVER (tenths)														
Sunrise - Sunset	45	7.2	6.9	6.8	6.3	6.3	6.0	6.2	6.0	5.6	5.1	6.3	6.9	6.3
MEAN NUMBER OF DAYS:														
Sunrise to Sunset														
-Clear	56	5.9	5.9	6.6	7.6	6.8	6.2	6.0	6.8	9.6	12.2	8.4	6.7	88.6
-Partly Cloudy	56	6.8	6.8	7.7	8.7	10.6	12.4	12.5	13.5	9.8	8.3	7.3	7.1	111.5
-Cloudy	56	18.3	15.6	16.7	13.7	13.6	11.4	12.5	10.8	10.6	10.5	14.3	17.2	165.2
Precipitation														
.01 inches or more	48	13.6	11.8	13.0	11.3	11.7	11.1	12.0	10.5	8.2	8.1	10.4	11.5	133.4
Snow, ice pellets, hail														
1.0 inches or more	50	1.7	1.2	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.9	4.7
Thunderstorms	50	0.3	0.9	2.0	3.4	6.4	8.1	9.3	7.4	3.5	0.8	0.4	0.2	42.8
Heavy Fog Visibility														
1/4 mile or less	50	3.2	2.4	1.4	1.6	3.5	3.6	4.9	7.1	5.6	5.0	2.8	3.1	44.3
Temperature of														
-Maximum														
90° and above	32	0.0	0.0	0.0	0.0	0.3	2.5	5.8	3.5	1.7	0.0	0.0	0.0	13.7
32° and below	32	5.1	2.8	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.6	11.2
-Minimum														
32° and below	32	23.1	19.7	13.3	3.6	0.2	0.0	0.0	0.0	0.0	2.9	12.5	20.4	95.8
0° and below	32	0.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.4
AVG. STATION PRESS. (mb)														
	21	964.5	963.8	962.2	961.9	962.3	963.3	964.4	965.0	965.3	965.7	965.3	965.2	964.1
RELATIVE HUMIDITY (%)														
Hour 01	32	77	74	72	72	83	87	88	89	88	84	79	78	81
Hour 07	32	80	79	79	81	88	90	92	93	93	89	84	81	86
Hour 13 (Local Time)	32	62	58	52	49	55	57	60	60	58	53	56	62	57
Hour 19	32	65	60	55	51	61	63	67	69	70	64	65	68	63
PRECIPITATION (inches):														
Water Equivalent														
-Normal		3.23	3.44	3.70	3.30	3.84	3.54	4.32	3.17	3.26	2.59	2.94	3.39	40.72
-Maximum Monthly	48	9.18	7.29	9.56	5.85	9.71	6.97	9.73	7.07	7.09	5.65	5.90	6.75	9.73
-Year		1957	1956	1955	1970	1950	1989	1949	1966	1972	1959	1948	1961	JUL 1949
-Minimum Monthly	48	1.37	0.75	1.31	0.21	1.31	0.75	0.79	0.55	0.50	0.07	1.07	0.21	0.07
-Year		1981	1968	1985	1976	1966	1986	1957	1987	1985	1963	1953	1965	OCT 1963
-Maximum in 24 hrs	48	2.34	2.02	3.35	2.66	3.26	3.10	2.90	3.07	3.61	3.65	2.55	2.95	3.65
-Year		1950	1991	1973	1977	1984	1954	1946	1982	1972	1964	1957	1969	OCT 1964
Snow, ice pellets, hail														
-Maximum Monthly	56	22.1	20.4	27.9	14.8	T	T	0.0	0.0	0.0	1.3	18.1	12.9	27.9
-Year		1966	1979	1960	1987	1992	1993				1993	1952	1963	MAR 1960
-Maximum in 24 hrs	50	9.7	10.7	14.2	10.0	T	T	0.0	0.0	0.0	1.3	16.2	9.6	16.2
-Year		1955	1969	1993	1987	1992	1993				1993	1952	1969	NOV 1952
WIND:														
Mean Speed (mph)	39	6.5	6.7	7.2	6.9	5.2	4.8	4.2	3.9	4.3	4.7	5.6	5.9	5.5
Prevailing Direction through 1963		WSW	NE	WNW	WSW	WSW	NE	WSW	NE	NE	NE	W	WSW	NE
Fastest Obs. 1 Min.														
-Direction (!!!)	38	25	25	25	25	32	27	23	34	31	28	26	24	32
-Speed (MPH)	38	40	46	40	41	50	39	40	46	29	35	37	40	50
-Year		1965	1961	1952	1977	1951	1989	1961	1962	1967	1965	1988	1968	MAY 1951
Peak Gust														
-Direction (!!!)	10	W	W	W	W	W	SW	SW	S	SW	W	W	W	W
-Speed (mph)	10	55	49	52	63	46	59	47	48	54	40	53	48	63
-Date		1987	1990	1988	1991	1990	1990	1990	1993	1984	1990	1988	1984	APR 1991

## PRECIPITATION (inches)

## BRISTOL, JOHNSON CITY, KINGSPORT, TENNESSEE

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
1964	3.25	4.11	4.66	4.65	2.27	1.14	3.73	3.79	3.14	4.95	1.88	2.48	40.05
1965	3.23	2.77	5.82	3.42	2.75	3.45	7.17	2.65	1.78	2.16	1.85	0.21	37.26
1966	3.30	3.50	2.05	5.04	1.31	1.77	6.21	7.07	4.73	3.50	3.71	3.07	45.26
1967	2.00	4.14	3.02	2.80	6.29	2.14	4.87	3.68	2.59	1.99	3.73	5.62	42.87
1968	3.58	0.75	4.95	4.12	3.83	2.89	2.89	2.32	0.93	2.51	1.89	2.13	32.79
1969	2.72	5.72	2.14	2.11	2.06	5.24	8.18	2.11	4.31	1.54	1.86	5.78	43.77
1970	2.89	2.75	1.60	5.85	1.60	2.48	2.95	4.28	1.67	3.29	1.33	3.40	34.09
1971	3.83	3.59	3.42	3.38	4.38	5.41	5.94	2.32	2.91	3.18	2.45	2.43	43.24
1972	4.87	4.81	2.86	2.92	5.92	2.97	3.18	2.70	7.09	4.57	2.85	6.43	51.17
1973	1.80	2.04	7.18	3.58	6.46	2.99	5.66	2.60	1.68	2.29	4.52	5.07	45.87
1974	5.33	4.07	4.34	3.96	8.66	4.01	1.78	1.95	3.12	2.34	3.29	3.53	46.38
1975	4.19	3.13	9.22	3.67	4.29	3.19	2.46	3.87	5.02	1.54	3.14	3.33	47.05
1976	2.60	3.07	3.24	0.21	3.31	5.62	2.14	2.27	4.44	5.30	1.41	3.80	37.41
1977	1.90	1.01	4.86	5.43	1.91	3.77	2.13	3.09	2.36	4.89	4.91	2.72	38.98
1978	4.22	0.89	3.18	2.44	4.50	5.67	4.78	3.71	3.04	0.58	2.64	4.89	40.54
1979	5.29	3.58	3.16	3.68	3.35	3.55	6.12	2.80	3.89	2.19	4.44	1.66	43.71
1980	3.91	1.39	5.68	3.56	2.69	1.10	3.82	2.54	3.01	2.09	2.10	1.38	33.27
1981	1.37	2.59	1.94	5.10	4.51	4.28	6.24	3.05	4.17	2.51	1.95	3.20	40.91
1982	4.07	5.07	3.35	2.30	2.55	5.52	9.14	4.70	5.53	2.54	4.12	2.89	51.78
1983	1.67	2.14	1.73	4.44	4.83	4.60	3.29	5.05	1.88	2.18	2.74	4.15	38.70
1984	1.79	4.50	2.73	2.85	7.42	3.86	4.63	1.23	1.43	1.14	2.61	1.76	35.95
1985	3.21	3.40	1.31	2.08	2.85	4.35	4.38	3.09	0.50	3.02	5.87	1.17	35.23
1986	1.55	4.11	1.56	0.51	4.16	0.75	5.50	3.40	3.93	1.69	2.67	3.66	33.49
1987	4.11	4.13	2.80	5.23	1.62	2.64	1.91	0.55	4.57	0.62	2.10	3.00	33.28
1988	2.74	3.20	1.54	2.69	2.48	0.89	3.20	2.78	3.20	1.79	3.44	2.73	30.68
1989	3.69	4.07	3.76	2.97	4.10	6.97	3.81	3.41	6.95	1.77	3.18	3.16	47.84
1990	3.23	5.06	4.00	2.44	6.57	2.90	3.78	3.51	1.47	5.23	1.32	4.85	44.36
1991	2.01	5.43	6.30	3.39	2.10	4.51	3.81	3.98	2.44	0.31	3.42	6.73	44.43
1992	2.42	3.52	2.62	1.53	5.46	3.44	5.11	2.41	1.49	3.42	2.25	5.05	38.72
1993	3.21	2.12	5.51	2.43	3.42	0.98	4.59	5.01	2.50	2.19	3.58	5.85	41.39
Record Mean	3.38	3.52	3.82	3.13	3.65	3.50	4.76	3.47	2.99	2.28	2.87	3.47	40.87

See Reference Notes on Page 6B.

Page 4A

## AVERAGE TEMPERATURE (deg. F)

## BRISTOL, JOHNSON CITY, KINGSPORT, TENNESSEE

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
1964	34.1	34.6	44.7	56.4	65.9	74.2	75.2	73.2	68.6	54.0	50.2	41.6	56.1
1965	36.5	37.3	43.6	57.9	68.1	71.2	74.5	73.9	71.3	55.7	47.6	38.9	56.4
1966	29.5	37.9	47.1	54.9	62.9	71.9	75.4	73.3	66.4	55.0	47.0	37.7	54.9
1967	38.2	33.7	50.2	57.7	58.7	68.9	69.8	70.7	62.6	56.1	42.7	40.8	54.2
1968	33.2	30.1	46.9	55.8	61.3	70.8	75.8	75.5	67.1	57.6	45.2	35.2	54.6
1969	34.3	35.8	38.6	54.7	63.0	73.1	76.4	73.0	66.2	55.7	41.4	34.5	53.9
1970	27.6	36.8	47.0	59.0	66.1	72.1	76.8	75.0	72.9	61.5	46.8	41.2	56.9
1971	35.6	36.9	43.0	55.1	61.5	73.9	74.0	73.7	72.3	63.4	46.5	47.5	57.0
1972	40.8	35.7	45.1	54.9	62.7	67.4	73.6	73.7	69.8	55.9	46.1	43.7	55.8
1973	35.8	36.9	53.9	53.9	60.7	73.1	74.7	73.4	71.4	60.3	48.8	39.3	56.8
1974	47.0	39.8	51.2	56.4	64.3	67.7	74.0	73.0	64.8	54.5	47.2	39.5	56.6
1975	40.4	42.8	44.7	54.2	67.1	71.1	74.8	76.1	67.8	59.0	49.8	40.0	57.3
1976	33.5	47.3	51.9	55.3	61.2	70.7	73.2	71.6	65.1	51.6	38.8	33.3	54.5
1977	22.1	34.5	50.0	59.4	66.8	71.2	76.8	74.8	69.6	53.3	49.9	35.3	55.3
1978	25.8	28.8	44.8	55.5	62.3	71.5	74.4	74.5	72.3	56.3	51.0	39.5	54.7
1979	30.4	31.9	48.3	55.4	63.8	68.2	70.9	73.1	66.8	54.6	48.7	38.8	54.2
1980	37.9	30.6	43.2	55.4	64.2	70.6	76.4	76.9	70.9	54.1	45.3	36.3	55.1
1981	29.3	37.9	42.6	60.4	61.3	75.1	75.3	72.1	65.0	53.7	45.8	34.5	54.4
1982	31.2	40.2	49.8	53.1	68.2	71.4	75.1	72.3	65.7	57.6	48.3	43.3	56.3
1983	35.1	38.2	46.4	50.5	60.9	69.5	74.2	74.7	65.9	57.1	45.3	34.8	54.4
1984	32.7	40.3	44.5	53.0	59.4	72.4	71.3	72.9	64.5	63.6	43.0	45.5	55.3
1985	27.6	35.5	48.2	57.0	63.8	69.5	73.2	71.2	66.1	61.4	55.3	33.9	55.2
1986	32.0	40.4	46.2	57.2	64.8	74.1	77.2	73.0	69.7	58.7	51.4	38.8	57.0
1987	34.7	39.9	47.8	52.0	69.3	73.5	77.0	77.5	68.2	50.8	48.5	41.6	56.7
1988	31.5	37.3	47.8	54.1	62.3	70.5	76.7	77.1	68.1	50.2	47.6	37.6	55.1
1989	42.3	39.5	51.2	54.7	59.8	71.9	75.1	73.3	67.8	56.6	45.6	28.1	55.5
1990	41.6	45.4	51.2	55.3	63.7	72.0	75.2	74.4	68.7	58.0	49.1	44.3	58.2
1991	38.8	41.2	49.2	59.7	69.6	72.0	76.6	73.2	67.7	58.1	46.1	40.6	57.7
1992	38.6	42.7	44.8	55.5	61.2	69.2	74.9	71.1	68.4	54.0	47.0	38.3	55.5
1993	41.7	37.4	43.6	53.2	64.7	72.7	79.6	73.8	67.1	55.3	46.8	38.3	56.2
Record Mean	35.8	38.9	46.6	55.5	64.4	71.9	75.0	73.9	68.2	57.3	46.5	38.3	56.0
Max	45.3	49.5	58.1	68.2	76.3	83.3	85.6	84.8	79.8	69.8	57.7	48.1	67.2
Min	26.2	28.2	35.1	42.9	52.4	60.4	64.4	63.0	56.5	44.7	35.2	28.5	44.8

See Reference Notes on Page 6B.

Page 4B

## HEATING DEGREE DAYS Base 65 deg. F

BRISTOL, JOHNSON CITY, KINGSFORT, TENNESSEE

SEASON	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
1964-65	0	13	26	349	436	719	874	772	656	223	17	5	4089
1965-66	0	3	21	292	513	803	1026	755	547	307	109	20	4471
1966-67	0	3	23	303	533	843	1091	868	455	218	216	29	4307
1967-68	12	2	107	271	662	745	979	1004	533	276	137	20	4749
1968-69	0	4	19	245	590	920	947	813	514	300	113	9	4774
1969-70	0	0	49	293	702	940	1155	784	553	201	66	1	4744
1970-71	0	0	26	147	538	737	903	676	610	296	135	0	4238
1971-72	0	0	26	147	538	737	743	844	676	307	136	36	3810
1972-73	0	0	10	281	559	652	898	779	324	333	152	30	4006
1973-74	0	0	12	169	483	792	552	700	424	257	86	14	3489
1974-75	0	0	72	326	527	785	755	616	621	328	29	1	4060
1975-76	0	0	46	188	451	768	970	509	402	297	134	9	3774
1976-77	0	0	46	409	776	973	1321	845	459	184	61	21	5095
1977-78	0	0	19	359	455	913	1207	1005	620	286	130	4	4998
1978-79	0	0	0	268	411	786	1065	920	511	283	88	11	4343
1979-80	3	3	23	323	483	804	832	990	670	285	76	4	4496
1980-81	0	3	31	337	586	882	1099	752	686	161	137	0	4671
1981-82	0	0	83	346	570	942	1042	687	465	351	32	0	4518
1982-83	0	0	66	256	494	667	922	745	570	436	140	19	4315
1983-84	0	0	98	242	583	928	955	709	627	357	199	8	4746
1984-85	0	2	91	73	652	599	1154	819	518	243	88	19	4256
1985-86	0	19	76	124	283	604	1015	681	577	240	30	0	4038
1986-87	0	0	2	227	402	804	932	698	527	393	113	45	4503
1987-88	0	0	24	436	512	718	1031	798	428	322	198	41	4192
1988-89	0	0	22	455	512	844	698	709	428	325	198	0	4114
1989-90	0	6	55	262	575	1139	718	540	423	303	93	0	4114
1990-91	0	6	48	225	474	636	806	659	483	175	32	0	3540
1991-92	0	3	68	224	562	750	813	638	417	293	148	22	4135
1992-93	0	0	32	337	532	820	714	767	657	346	165	10	4283
1993-94	0	0	59	298	537	823	714	767	657	346	165	10	4283

See Reference Notes on Page 5A.  
Page 5A

## COOLING DEGREE DAYS Base 65 deg. F

BRISTOL, JOHNSON CITY, KINGSFORT, TENNESSEE

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL
1969	0	0	0	0	60	261	363	255	93	14	0	0	1046
1970	0	0	0	28	106	220	373	314	270	45	100	0	1356
1971	0	0	0	5	22	113	285	274	160	44	100	0	1155
1972	0	0	0	11	26	249	309	267	212	32	1	0	862
1973	0	0	0	9	73	102	286	254	73	57	1	0	1101
1974	0	0	0	12	101	190	310	353	136	57	1	0	803
1975	0	0	0	14	124	185	326	309	154	70	0	0	1109
1976	0	0	0	23	124	213	374	302	163	24	0	0	1217
1977	0	0	0	5	53	204	299	259	224	4	0	0	1092
1978	0	0	0	6	59	113	194	237	85	5	0	0	720
1979	0	0	0	1	61	179	355	237	215	5	0	0	1205
1980	0	0	0	27	30	309	325	226	97	36	0	0	1018
1981	0	0	0	27	30	199	325	232	93	3	0	0	926
1982	0	0	0	27	30	199	325	232	93	3	0	0	926
1983	0	0	0	27	30	199	325	232	93	3	0	0	926
1984	0	0	0	27	30	199	325	232	93	3	0	0	926
1985	0	0	0	27	30	199	325	232	93	3	0	0	926
1986	0	0	0	27	30	199	325	232	93	3	0	0	926
1987	0	0	0	27	30	199	325	232	93	3	0	0	926
1988	0	0	0	27	30	199	325	232	93	3	0	0	926
1989	0	0	0	27	30	199	325	232	93	3	0	0	926
1990	0	0	0	27	30	199	325	232	93	3	0	0	926
1991	0	0	0	27	30	199	325	232	93	3	0	0	926
1992	0	0	0	27	30	199	325	232	93	3	0	0	926
1993	0	0	0	27	30	199	325	232	93	3	0	0	926

See Reference Notes on Page 5B.  
Page 5B

## SNOWFALL (inches)

BRISTOL, JOHNSON CITY, KINGSPORT, TENNESSEE

SEASON	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
1964-65	0.0	0.0	0.0	0.0	0.7	T	7.5	9.0	5.5	0.0	0.0	0.0	22.7
1965-66	0.0	0.0	0.0	T	T	0.1	22.1	0.3	T	T	0.0	0.0	22.5
1966-67	0.0	0.0	0.0	0.0	1.9	5.8	4.6	4.8	T	0.0	0.0	0.0	17.1
1967-68	0.0	0.0	0.0	0.0	T	4.1	12.1	6.3	1.0	0.0	0.0	0.0	23.5
1968-69	0.0	0.0	0.0	T	2.9	1.0	5.9	15.1	4.4	0.0	0.0	0.0	29.3
1969-70	0.0	0.0	0.0	0.0	1.0	9.7	10.1	7.8	0.6	0.0	0.0	0.0	29.2
1970-71	0.0	0.0	0.0	0.0	0.4	4.2	4.5	9.9	6.3	T	0.0	0.0	25.3
1971-72	0.0	0.0	0.0	0.0	0.7	4.3	T	5.3	2.4	T	0.0	0.0	12.7
1972-73	0.0	0.0	0.0	0.0	2.1	0.1	4.2	1.2	T	T	0.0	0.0	7.6
1973-74	0.0	0.0	0.0	0.0	0.0	3.3	0.0	0.9	T	T	0.0	0.0	4.2
1974-75	0.0	0.0	0.0	0.0	0.5	3.1	1.8	0.3	3.4	T	0.0	0.0	9.1
1975-76	0.0	0.0	0.0	0.0	T	T	0.5	3.2	T	0.0	0.0	0.0	3.7
1976-77	0.0	0.0	0.0	0.0	1.2	6.2	12.7	2.4	0.4	T	0.0	0.0	22.9
1977-78	0.0	0.0	0.0	T	1.6	0.4	13.6	6.7	3.9	T	0.0	0.0	26.2
1978-79	0.0	0.0	0.0	0.0	0.0	T	9.2	20.4	0.8	0.0	0.0	0.0	30.4
1979-80	0.0	0.0	0.0	0.0	T	0.4	7.8	5.4	3.6	0.0	0.0	0.0	17.2
1980-81	0.0	0.0	0.0	0.0	T	T	7.3	1.1	1.1	0.0	0.0	0.0	9.5
1981-82	0.0	0.0	0.0	0.0	T	7.3	3.6	2.3	2.6	0.6	0.0	0.0	16.4
1982-83	0.0	0.0	0.0	0.0	0.0	6.3	3.4	5.5	1.1	5.6	0.0	0.0	21.9
1983-84	0.0	0.0	0.0	0.0	T	0.3	4.6	3.8	1.2	T	0.0	0.0	9.9
1984-85	0.0	0.0	0.0	0.0	0.0	0.3	9.7	6.0	T	T	0.0	0.0	16.0
1985-86	0.0	0.0	0.0	0.0	0.0	3.2	10.5	7.7	T	T	0.0	0.0	21.4
1986-87	0.0	0.0	0.0	0.0	T	0.2	12.2	4.0	0.3	14.8	0.0	0.0	31.5
1987-88	0.0	0.0	0.0	0.0	0.8	0.2	7.6	T	0.4	0.0	0.0	0.0	9.0
1988-89	0.0	0.0	0.0	T	T	2.3	3.7	11.0	T	T	T	0.0	17.0
1989-90	0.0	0.0	0.0	0.1	0.9	6.9	0.7	0.4	0.5	T	0.0	0.0	9.5
1990-91	0.0	0.0	0.0	0.0	0.0	T	T	1.4	T	0.0	0.0	0.0	1.4
1991-92	0.0	0.0	0.0	0.0	T	T	0.2	T	0.1	0.4	T	0.0	0.7
1992-93	0.0	0.0	0.0	0.0	T	3.5	T	2.3	14.2	T	0.0	T	20.0
1993-94	0.0	0.0	0.0	1.3	T	1.9							
Record Mean	0.0	0.0	0.0	T	1.0	2.6	5.1	4.3	2.3	0.4	T	T	15.8

See Reference Notes on Page 6B.  
Page 6A

## REFERENCE NOTES

BRISTOL, JOHNSON CITY, KINGSPORT, TENNESSEE

## GENERAL

T - TRACE AMOUNT.  
BLANK ENTRIES DENOTE MISSING/UNREPORTED DATA.  
# INDICATES A STATION OR INSTRUMENT RELOCATION.  
SEE STATION LOCATION TABLE ON PAGE 8.

## SPECIFIC

## PAGE 2

PM - INCLUDES LAST DAY OF PREVIOUS MONTH  
ASOS - AUTOMATED SURFACE OBSERVING SYSTEM IN OPERATION DURING THESE MONTHS.

## PAGE 3

1st - LENGTH OF RECORD IN YEARS, ALTHOUGH INDIVIDUAL MONTHS MAY BE MISSING.  
0.1 OR \* - THE VALUE IS BETWEEN 0.0 AND 0.05  
NORMALS - BASED ON THE 1961-1990 RECORD PERIOD.  
EXTREMES - DATES ARE THE MOST RECENT OCCURRENCE  
WIND DIR. - NUMERALS SHOW TENS OF DEGREES CLOCKWISE FROM TRUE NORTH. "CC" INDICATES CALM.  
RESULTANT DIRECTIONS ARE GIVEN TO WHOLE DEGREES  
BOLD VALUES INDICATE EXTREME VALUES WHICH OCCURRED AFTER THE ASOS SYSTEM WAS COMMISSIONED.

## PAGE 4B

RECORD = PERIOD OF RECORD  
RECORD MEAN PRECIPITATION IS THE MEAN OF ALL DAILY PRECIPITATION AMOUNTS DURING THE PERIOD OF RECORD.  
RECORD MAXIMUM TEMPERATURE IS THE MEAN OF ALL DAILY MAXIMUM TEMPERATURES DURING THE PERIOD OF RECORD.  
RECORD MEAN TEMPERATURE IS THE SUM OF THE RECORD MAX AND RECORD MIN DIVIDED BY 2.  
AVERAGE TEMPERATURE IS THE SUM OF THE MEAN DAILY MAX AND MIN TEMPERATURE DIVIDED BY 2.

## EXCEPTIONS

PAGES 4A, 4B, 6A

RECORD MEANS ARE THROUGH THE CURRENT YEAR,  
BEGINNING IN 1938 FOR TEMPERATURE  
1938 FOR PRECIPITATION  
1938 FOR SNOWFALL

## BRISTOL, JOHNSON CITY, KINGSPORT, TENNESSEE

The Weather Service Office is located an almost equal distance of 15 miles in the middle of a geographical triangle between the cities of Bristol, Tennessee-Virginia, Kingsport and Johnson City, Tennessee, and is more commonly known as the Tri-City Area. This location is situated in the extreme upper East Tennessee Valley. The terrain immediately surrounding the station ranges from gently rolling on the east and south to very hilly on the west and north. Mountain ranges begin about 10 miles to the southeast and about 15 miles to the west and north, with many peaks and ridges rising to 4,000 feet, and some to 6,000 feet toward the southeast.

This section does not lie directly within any of the principal storm tracks that cross the country, but comes under the influence of storm centers that pass along the Gulf Coast and then up the Atlantic Coast toward the northeast. Being quite varied, the topography has considerable influence on the weather. Moist air from the east is forced up the slopes of the mountains causing much of the moisture to be precipitated before the air mass reaches the Bristol area. The same process occurs to a lesser extent when air masses move over the smaller mountain ranges to the west and north. The maximum monthly precipitation occurs in July, usually from afternoon and early evening thunderstorms. A second maximum of precipitation occurs in the late winter months, due mainly to moist air associated with storm centers to the south or northeast. Annual precipitation amounts recorded in mountainous sections to the east and southeast are almost double what they are in the immediate vicinity.

Lowest temperatures normally occur during the early morning hours, but rise rapidly during the morning hours. Periods of cold weather are generally associated with air flow from winter storm centers near the northeast coast. Periods of unusually high temperatures occur most frequently when Gulf air associated with the Bermuda high pressure system dominates the area.

Snowfall seldom occurs before November and rarely remains on the ground for more than a few days. However, mountains to the east and south of the station are frequently well blanketed with snow for much longer periods of time.

Agricultural activities within this area include such staple crops as tobacco, beans, and hay which are raised in such amounts as to be important commercially. The last freezing temperature in spring normally occurs in late April, and the first in autumn around mid-October. The growing season of 180 days, usually coupled with ample sunshine and rainfall, permits a second planting and harvesting of some staple crops.

### Notice of Correction

Any previously received edition of the "Local Climatological Data Annual Summary for 1993" should be discarded. This revised edition contains updates to the "Normals" based upon the 1961-1990 record period as noted in the "Reference Notes" on Page 6B.

## OAK RIDGE, TENNESSEE

Oak Ridge is located in a broad valley between the Cumberland Mountains, which lie to the northwest of the area, and the Great Smoky Mountains, to the southeast. These mountain ranges are oriented northeast-southwest and the valley between is corrugated by broken ridges 300 to 500 feet high and oriented parallel to the main valley. During periods of light winds, daytime winds are usually southwesterly, nighttime winds northeasterly. Wind velocities are somewhat decreased by the ridges. Tornadoes rarely occur in the valley between the Cumberlands and the Great Smokies. In winter the Cumberland Mountains have a moderating influence on the local climate by retarding the flow of cold air from the north and west.

Temperatures of 100 degrees or more have occurred during less than one-half of the years of the period of record, and temperatures of zero or below are rare. Summer nights are seldom oppressively hot and humid.

Precipitation is more than adequate for agriculture and is normally well distributed through the year for agricultural purposes.

Occasionally there is sufficient dry weather in late summer or early fall to cause small damage to crops and pastures and to create conditions favorable for destructive forest fires. Winter and early spring are the seasons of heaviest precipitation. A few of the larger monthly precipitation amounts recorded have occurred in the normally drier fall months.

Light snow usually occurs in all of the months from November through March, but the total monthly snowfall is often only a trace. Snowfalls sufficiently heavy to interfere with traffic and outdoor activities occur infrequently.

Based on the 1951-1980 period, the average first occurrence of 32 degrees Fahrenheit in the fall is October 27 and the average last occurrence in the spring is April 11.



NOAA 1994



# LOCAL CLIMATOLOGICAL DATA

## ANNUAL SUMMARIES FOR 1993

PART IV • WESTERN REGION

AZ  
CA  
ID  
MT  
NV  
OR  
UT  
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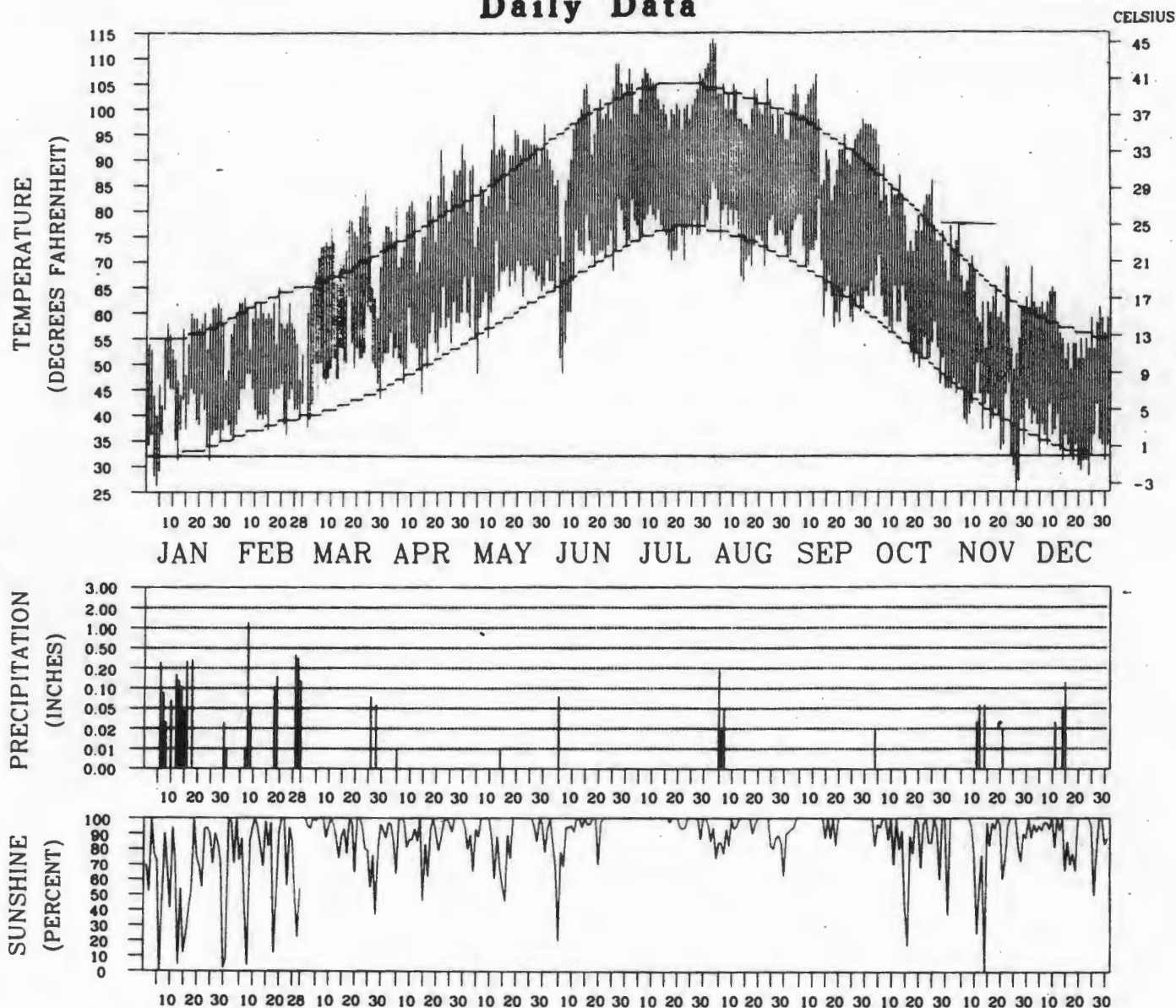
1993

# LOCAL CLIMATOLOGICAL DATA ANNUAL SUMMARY WITH COMPARATIVE DATA

LAS VEGAS,  
NEVADA



## Daily Data



TEMPERATURE DEPICTS NORMAL MAXIMUM, NORMAL MINIMUM AND ACTUAL DAILY HIGH AND LOW VALUES (FAHRENHEIT)  
PRECIPITATION IS MEASURED IN INCHES. SCALE IS NON-LINEAR  
SUNSHINE IS PERCENT OF THE POSSIBLE SUNSHINE

I CERTIFY THAT THIS IS AN OFFICIAL PUBLICATION OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, AND IS COMPILED FROM RECORDS ON FILE AT THE NATIONAL CLIMATIC DATA CENTER, ASHEVILLE, NORTH CAROLINA, 28801

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CLIMATIC DATA CENTER  
ASHEVILLE NORTH CAROLINA

*Kenneth D. Haden*  
DIRECTOR  
NATIONAL CLIMATIC DATA CENTER

# METEOROLOGICAL DATA FOR 1993

LAS VEGAS, NEVADA

LATITUDE: 36°05' N LONGITUDE: 115°10' W ELEVATION: FT GRND 2162 BARO 2179 TIME ZONE: PACIFIC WBAN: 23169

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F:													
Averages													
-Daily Maximum	53.7	58.5	72.4	80.1	89.5	95.7	102.6	101.4	95.5	81.6	63.2	57.8	79.3
-Daily Minimum	37.6	41.7	49.3	54.8	64.3	69.2	76.2	75.5	67.0	56.5	39.7	34.7	55.6
-Monthly	45.7	50.1	60.9	67.5	77.0	82.5	89.4	88.5	81.3	69.1	51.5	46.3	67.5
-Monthly Dewpt.	33.0	34.3	36.7	25.8	36.9	32.3	37.6	41.7	32.4	28.5	19.0	21.0	31.6
Extremes													
-Highest	62	65	84	93	99	109	109	114	107	97	77	69	114
-Date	27	19	23	29	...	27	31	2	11	2	4	2	AUG 2
-Lowest	26	35	37	44	43	48	70	66	57	45	25	28	25
-Date	4	2	1	14	...	6	22	14	18	31	26	24	NOV 26
DEGREE DAYS BASE 65 °F:													
Heating	591	410	143	32	3	8	0	0	0	33	398	573	2191
Cooling	0	0	21	114	38	537	765	737	494	166	0	0	3215
% OF POSSIBLE SUNSHINE	60	74	88	89	88	91	99	91	98	85	85	90	87
AVG. SKY COVER (tenths)													
Sunrise - Sunset	7.3	5.3	5.1	5.3	3.8	2.4	1.5	2.2	0.5	3.3	3.5	3.4	3.6
Midnight - Midnight	6.4	5.3	4.5	4.4	3.2	2.4	1.2	2.2	0.4	2.9	3.1	3.1	3.3
NUMBER OF DAYS:													
Sunrise to Sunset													
-Clear	6	11	13	9	16	21	26	24	29	20	18	18	211
-Partly Cloudy	6	6	5	10	7	5	3	6	1	4	5	8	66
-Cloudy	19	11	13	11	8	4	2	1	0	7	7	5	88
Precipitation													
.01 inches or more	12	8	2	1	1	1	0	3	0	1	4	3	36
Snow, ice pellets, hail													
1.0 inches or more	0	0	0	0	0	0	0	0	0	0	0	0	0
Thunderstorms	0	0	0	0	2	1	0	4	0	0	1	0	8
Heavy Fog, visibility													
1/4 mile or less	3	0	0	0	0	0	0	0	0	0	0	0	3
Temperature °F													
-Maximum													
90° and above	0	0	0	3	20	23	31	31	24	5	0	0	137
32° and below	0	0	0	0	0	0	0	0	0	0	0	0	0
-Minimum													
32° and below	5	0	0	0	0	0	0	0	0	0	4	11	20
0° and below	0	0	0	0	0	0	0	0	0	0	0	0	0
AVG. STATION PRESS. (mb)	939.7	938.4	940.1	935.7	934.3	933.0	933.3	935.0	936.7	939.0	941.8	943.8	937.7
RELATIVE HUMIDITY (%)													
Hour 04	73	71	60	33	35	28	23	29	24	32	39	50	41
Hour 10	60	53	39	19	22	16	16	21	16	22	28	34	29
Hour 16 (Local Time)	55	44	28	13	17	12	12	16	14	17	23	26	23
Hour 22	70	65	51	25	25	18	16	23	17	25	34	44	34
PRECIPITATION (inches):													
Water Equivalent													
-Total	1.63	2.52	0.14	0.01	0.01	0.08	0.00	0.26	0.00	0.02	0.17	0.21	5.05
-Greatest (24 hrs)	0.34	1.30	0.08	0.01	0.01	0.08	0.00	0.19	0.00	0.02	0.06	0.18	1.30
-Date	6-7	7-8	26	5	14	5	...	5	...	4	14	14-15	FEB 7-8
Snow, ice pellets, hail													
-Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-Greatest (24 hrs)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-Date	...	...	...	...	...	...	...	...	...	...	...	...	...
WIND:													
Resultant													
-Direction (!!!)	230	219	233	246	211	230	204	202	230	254	296	287	226
-Speed (mph)	2.4	3.8	1.8	4.1	5.1	5.8	7.7	5.0	3.5	2.4	1.7	2.4	3.5
Average Speed (mph)	7.6	8.7	8.3	11.0	11.3	11.5	10.3	9.0	8.6	8.5	8.0	7.2	9.2
Fastest Obs. 1 Min.													
-Direction (!!!)	22	24	22	23	23	23	23	33	32	02	34	33	23
-Speed (mph)	28	33	25	32	38	32	26	26	31	29	25	31	38
-Date	11	20	17	22	3	20	3	5	17	26	14	12	MAY 3
Peak Gust													
-Direction (!!!)	SW	W	SE	SW	SW	N	SW	S	SW	S	S	NW	SW
-Speed (mph)	38	44	35	41	52	48	35	38	48	38	41	40	52
-Date	8	20	25	22	3	16	15	4	16	5	23	12	MAY 3

(!!!) See Reference Notes on Page 68  
Page 2

# NORMALS, MEANS, AND EXTREMES

LAS VEGAS, NEVADA

LATITUDE: 36°05'N LONGITUDE: 115°10'W ELEVATION: FT. GRND 2162 BARO 2179 TIME ZONE: PACIFIC WBAN: 23169

	(a)	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	YEAR
<b>TEMPERATURE °F:</b>														
Normals														
-Daily Maximum		57.3	63.3	68.8	77.5	87.8	100.3	105.9	103.2	94.7	82.1	67.4	57.5	80.5
-Daily Minimum		33.6	38.8	43.8	50.7	60.2	69.4	76.2	74.2	66.2	54.3	42.6	33.9	53.7
-Monthly		45.5	51.1	56.3	64.1	74.0	84.9	91.1	88.7	80.5	68.3	55.0	45.7	67.1
Extremes														
-Record Highest	45	77	87	91	99	109	115	116	116	113	103	87	77	116
-Year		1975	1986	1966	1981	1951	1970	1985	1979	1950	1978	1988	1980	JUL 1985
-Record Lowest	45	8	16	23	31	40	48	60	56	46	26	21	11	8
-Year		1963	1989	1971	1975	1964	1993	1987	1968	1965	1971	1952	1990	JAN 1963
<b>NORMAL DEGREE DAYS:</b>														
Heating (base 65°F)		605	389	292	143	14	0	0	0	0	62	304	598	2407
Cooling (base 65°F)		0	0	22	116	293	597	809	735	465	164	0	0	3201
% OF POSSIBLE SUNSHINE	44	77	80	83	87	88	93	88	88	91	87	81	79	85
<b>MEAN SKY COVER (tenths)</b>														
Sunrise - Sunset	45	4.8	4.7	4.6	3.8	3.4	2.1	2.8	2.5	2.1	2.8	3.9	4.4	3.5
<b>MEAN NUMBER OF DAYS:</b>														
Sunrise to Sunset														
-Clear	45	13.8	12.4	13.6	15.8	17.9	22.2	20.1	21.6	22.6	20.4	15.9	14.9	211.1
-Partly Cloudy	45	6.4	6.9	8.5	7.6	8.0	5.2	7.5	6.6	5.0	6.3	7.3	6.7	82.0
-Cloudy	45	10.9	9.0	8.9	6.6	5.1	2.6	3.4	2.8	2.4	4.2	6.8	9.4	72.2
Precipitation														
0.1 inches or more	45	3.2	2.8	3.2	1.8	1.4	0.7	2.6	2.9	1.6	1.8	2.0	2.6	26.5
Snow, ice pellets, hail														
1.0 inches or more	45	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.4
Thunderstorms	45	0.3	0.2	0.4	0.5	1.0	1.0	4.0	4.0	1.6	0.5	0.2	0.3	13.4
Heavy Fog Visibility														
1/4 mile or less	45	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.1	0.2	0.8
Temperature °F														
-Maximum														
90° and above	33	0.0	0.0	0.3	3.3	15.4	25.7	30.5	29.8	22.2	6.0	0.0	0.0	132.9
32° and below	33	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2
-Minimum														
32° and below	33	12.5	4.3	1.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	2.2	11.2	31.5
0° and below	33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AVG. STATION PRESS. (mb)	21	942.3	940.7	937.3	935.9	933.9	933.6	934.9	935.6	936.0	938.7	940.8	942.5	937.7
<b>RELATIVE HUMIDITY (%)</b>														
Hour 04	33	56	51	46	35	32	25	29	35	33	37	46	55	40
Hour 10	33	42	36	31	22	19	15	19	24	22	25	32	40	27
Hour 16 (Local Time)	33	31	27	22	16	14	11	15	17	17	19	26	32	21
Hour 22	33	50	43	37	26	23	17	22	26	26	30	40	49	32
<b>PRECIPITATION (inches):</b>														
Water Equivalent														
-Normal		0.48	0.48	0.42	0.21	0.28	0.12	0.35	0.49	0.28	0.21	0.43	0.38	4.13
-Maximum Monthly	45	2.41	2.52	4.80	2.44	0.96	0.97	2.48	2.59	1.58	1.22	2.22	1.71	4.80
-Year		1949	1993	1992	1965	1969	1990	1984	1957	1963	1992	1965	1992	MAR 1992
-Minimum Monthly	45	T	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
-Year		1984	1977	1972	1962	1970	1982	1981	1980	1971	1979	1980	1981	JUN 1982
-Maximum in 24 hrs	45	1.09	1.30	1.27	0.97	0.83	0.97	1.36	2.59	1.07	1.09	1.78	0.95	2.59
-Year		1990	1993	1992	1965	1987	1990	1984	1957	1963	1992	1960	1977	AUG 1957
Snow, ice pellets, hail														
-Maximum Monthly	45	16.7	1.4	0.1	T	0.0	0.0	0.0	T	0.0	T	4.0	2.0	16.7
-Year		1949	1990	1976	1970				1989		1956	1964	1967	JAN 1949
-Maximum in 24 hrs	45	9.0	6.9	0.1	T	0.0	0.0	0.0	T	0.0	T	4.0	2.0	9.0
-Year		1974	1979	1976	1970				1989		1956	1964	1967	JAN 1974
<b>WIND:</b>														
Mean Speed (mph)	45	7.4	8.6	10.2	11.0	11.1	11.1	10.3	9.6	9.0	8.1	7.8	7.3	9.3
Prevailing Direction through 1963		W	SW	SW	SW	SW	SW	SW	SW	SW	WSW	W	W	SW
Fastest Obs. 1 Min.														
-Direction (!!!)	8	23	23	23	22	32	34	10	14	22	31	21	30	32
-Speed (MPH)	8	39	50	51	49	53	48	38	40	35	47	43	40	53
-Year		1987	1989	1989	1988	1991	1989	1984	1989	1989	1989	1985	1984	MAY 1991
Peak Gust														
-Direction (!!!)	10	SW	NW	NW	W	NW	NE	SW	SE	SW	SW	SW	SW	SE
-Speed (mph)	10	54	67	82	69	72	59	53	90	49	52	68	54	90
-Date		1987	1984	1984	1988	1991	1984	1984	1989	1989	1984	1987	1990	AUG 1989

## PRECIPITATION (inches)

## LAS VEGAS, NEVADA

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
1964	0.05	0.02	0.02	0.03	0.05	0.03	0.24	0.05	T	T	0.63	T	1.12
1965	0.05	0.45	0.74	2.44	0.40	T	0.28	0.38	T	T	2.22	1.00	7.96
1966	T	0.07	0.04	0.01	T	0.15	0.30	0.09	0.35	0.09	0.33	0.48	1.91
1967	0.47	0.00	T	0.09	0.21	0.82	0.20	0.38	1.03	0.00	1.52	0.82	5.54
1968	0.01	0.22	0.22	0.10	T	0.31	0.11	0.04	0.01	T	0.02	0.07	1.11
1969	1.57	0.96	0.57	T	0.96	0.23	0.06	0.33	0.08	0.27	0.06	T	5.09
1970	0.01	0.86	0.28	0.04	0.00	0.18	0.58	1.79	0.00	0.02	0.38	0.15	4.29
1971	T	0.03	T	T	0.84	T	0.08	0.90	0.00	0.06	0.12	0.51	2.54
1972	0.00	T	0.00	0.07	0.46	0.32	0.13	0.84	0.63	1.12	1.09	0.19	4.85
1973	0.49	1.64	1.83	0.35	0.09	0.03	T	0.08	T	0.02	0.14	0.01	4.68
1974	2.00	0.11	0.16	T	T	0.00	0.58	0.08	0.16	0.61	0.23	0.59	4.52
1975	0.01	0.05	1.07	0.42	0.35	T	0.26	0.06	1.17	0.03	T	0.05	3.47
1976	0.00	2.49	0.02	0.13	0.34	0.00	1.95	0.00	1.09	0.70	0.02	0.03	6.77
1977	0.21	0.00	0.28	0.01	0.72	0.05	T	1.38	0.19	0.06	0.01	1.06	3.97
1978	1.00	1.51	1.13	0.36	0.54	0.00	0.19	0.53	0.03	0.62	0.59	1.15	7.65
1979	2.18	0.07	0.96	0.06	0.35	0.00	0.78	2.12	T	0.00	0.03	0.24	6.79
1980	1.45	2.25	0.94	0.18	0.15	T	0.43	0.00	0.18	0.04	0.00	0.01	5.63
1981	0.09	0.20	1.44	0.02	0.50	T	0.00	0.20	0.25	0.15	0.29	0.00	3.14
1982	0.09	1.10	0.29	0.01	0.31	0.00	0.05	0.71	0.07	0.04	0.60	0.72	3.99
1983	0.43	0.32	0.90	0.45	0.16	T	0.06	1.25	0.50	0.26	0.10	0.43	4.86
1984	T	0.03	T	0.04	0.00	0.22	2.48	0.99	0.47	T	0.94	1.68	6.85
1985	0.19	0.02	0.06	0.31	T	0.02	0.13	0.00	0.08	0.07	0.37	0.02	1.27
1986	0.23	0.15	0.32	0.10	0.28	T	0.13	0.04	0.05	0.07	0.81	0.47	2.65
1987	1.13	0.45	0.49	0.17	0.90	0.13	0.13	0.01	T	0.49	1.80	0.89	6.59
1988	0.65	0.26	0.00	0.76	T	0.04	0.04	0.46	T	0.00	T	0.08	2.29
1989	0.51	0.06	0.05	T	0.64	T	0.05	0.80	T	T	0.00	T	2.11
1990	1.18	0.37	T	0.18	T	0.97	0.59	T	0.19	0.17	0.10	T	3.75
1991	0.21	0.54	1.01	T	0.05	0.19	0.54	0.78	0.06	0.06	0.38	0.24	4.06
1992	0.45	1.30	4.80	0.02	0.05	0.09	0.03	0.21	0.00	1.22	0.00	1.71	9.88
1993	1.63	2.52	0.14	0.01	0.01	0.08	0.00	0.26	0.00	0.02	0.17	0.21	5.05
Record Mean	0.53	0.48	0.51	0.22	0.18	0.08	0.41	0.48	0.30	0.24	0.37	0.40	4.21

See Reference Notes on Page 6B.  
Page 4A

## AVERAGE TEMPERATURE (deg. F)

## LAS VEGAS, NEVADA

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	ANNUAL
1964	42.0	45.6	52.3	61.8	70.9	80.9	90.7	87.6	78.4	72.0	50.0	45.3	64.8
1965	47.1	49.5	53.2	61.2	69.6	78.0	88.7	87.9	74.8	69.8	55.9	45.0	65.1
1966	42.7	45.8	57.9	66.4	77.5	83.9	89.3	89.6	80.1	66.5	55.4	46.1	66.8
1967	45.3	50.6	59.3	56.2	72.5	79.6	91.7	90.3	80.0	69.1	56.7	41.6	66.1
1968	44.2	55.7	57.5	62.0	73.5	84.0	89.0	83.5	79.7	67.0	54.5	40.8	66.0
1969	47.5	46.3	53.0	64.4	76.8	81.4	89.7	92.2	82.5	62.8	53.5	45.8	66.3
1970	44.0	52.5	54.9	58.6	75.3	83.4	91.1	88.8	77.2	63.8	55.0	44.5	65.8
1971	44.4	49.7	55.8	63.0	68.0	83.3	92.8	89.0	77.6	61.7	50.9	41.4	64.8
1972	42.3	52.0	63.7	65.1	74.5	84.7	93.1	86.5	78.0	63.5	49.7	41.3	66.2
1973	40.9	49.6	50.7	62.2	76.7	85.2	91.7	87.6	78.9	67.7	53.4	46.2	65.9
1974	41.0	48.9	59.5	63.4	77.0	89.1	88.8	87.7	83.4	69.3	54.8	44.4	67.3
1975	45.3	48.8	53.9	56.6	72.5	83.8	90.3	87.5	81.7	66.1	53.0	48.2	65.6
1976	46.9	53.2	53.4	62.6	77.8	81.5	86.9	85.5	78.7	66.5	58.0	46.4	66.5
1977	45.7	54.2	52.6	68.6	67.7	88.0	92.4	90.1	80.6	71.4	57.2	51.9	68.3
1978	47.9	52.1	59.9	63.1	73.1	87.1	91.9	89.0	79.0	73.5	54.2	42.9	67.8
1979	41.1	48.4	56.0	66.1	75.4	85.5	91.1	85.9	85.3	70.7	51.6	47.2	67.1
1980	49.5	53.2	54.2	63.5	69.0	83.9	92.0	90.2	81.4	68.9	56.8	52.7	67.9
1981	51.1	52.5	56.4	70.6	74.3	88.8	92.7	90.0	82.5	64.4	58.0	48.8	69.2
1982	45.6	50.5	55.1	63.8	73.6	81.5	88.1	87.3	77.9	63.0	50.5	44.5	65.1
1983	46.6	51.7	56.4	58.5	72.8	82.8	88.5	83.8	82.5	67.8	55.3	47.9	66.2
1984	47.1	50.1	57.9	63.1	80.7	83.5	88.2	85.4	81.7	63.0	52.7	44.0	66.5
1985	44.4	47.4	54.9	68.2	76.9	87.4	92.0	89.9	75.4	67.3	51.7	48.3	67.0
1986	51.7	55.8	63.0	66.2	76.6	87.8	87.6	91.2	75.4	65.0	55.8	46.0	68.5
1987	44.7	51.4	54.6	68.4	74.5	86.3	86.9	88.2	81.2	71.0	53.4	42.5	66.9
1988	45.1	52.4	58.1	64.2	73.4	85.3	92.6	86.9	79.1	74.9	56.0	46.0	67.8
1989	43.9	50.0	63.4	72.7	75.7	85.3	93.4	86.9	80.0	67.2	57.3	48.0	68.7
1990	45.2	48.8	60.5	68.8	74.5	85.9	90.8	87.8	82.0	69.2	55.1	40.2	67.4
1991	45.5	55.9	52.7	64.2	69.9	82.1	90.2	87.8	81.9	72.2	55.2	47.0	67.1
1992	45.9	54.1	56.8	70.5	77.7	83.2	88.7	90.5	83.7	70.9	52.7	43.6	68.2
1993	45.7	50.1	60.9	67.5	77.0	82.5	89.4	88.5	81.3	69.1	51.5	46.3	67.5
Record Mean	44.6	49.9	55.8	64.6	73.9	83.5	89.8	87.7	80.0	67.3	53.5	45.7	66.3
Max	56.5	62.4	68.9	78.5	88.3	98.6	104.5	102.2	94.8	81.7	66.6	57.7	80.0
Min	32.7	37.4	42.7	50.6	59.4	68.3	75.0	73.2	65.1	53.0	40.4	33.6	52.6

See Reference Notes on Page 6B.  
Page 4B

## HEATING DEGREE DAYS Base 65 deg. F

LAS VEGAS, NEVADA

SEASON	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
1964-65	0	0	0	12	444	606	551	427	358	220	49	0	2667
1965-66	0	0	15	17	266	615	606	529	235	54	0	0	2416
1966-67	0	0	0	47	286	578	685	397	189	261	25	0	2389
1967-68	0	0	0	18	244	716	636	265	231	110	8	0	2230
1968-69	0	0	1	28	304	743	536	518	381	74	16	0	2601
1969-70	0	0	0	112	341	589	643	344	304	208	8	0	2549
1970-71	0	0	0	111	295	631	630	421	306	105	47	0	2546
1971-72	0	0	4	207	417	724	697	373	99	169	6	0	2596
1972-73	0	0	0	108	453	727	744	428	437	132	12	0	3041
1973-74	0	0	0	42	349	576	738	443	188	82	13	0	2431
1974-75	0	0	0	55	300	634	607	446	340	249	37	0	2668
1975-76	0	0	0	73	354	516	553	339	357	124	1	0	2317
1976-77	0	0	0	39	212	569	593	297	374	45	56	0	2185
1977-78	0	0	0	3	226	399	522	356	168	91	16	0	1781
1978-79	0	0	1	2	324	676	737	458	270	66	18	0	2552
1979-80	0	0	0	44	395	546	474	335	328	108	32	0	2262
1980-81	0	0	0	82	255	374	426	344	263	129	32	0	1775
1981-82	0	0	0	74	214	497	594	398	301	98	9	0	2185
1982-83	0	0	10	84	429	631	564	364	263	198	21	0	2564
1983-84	0	0	0	3	297	524	548	424	216	111	0	0	2123
1984-85	0	0	0	127	363	641	629	487	308	41	0	0	2596
1985-86	0	0	1	31	393	512	404	270	125	57	11	0	1804
1986-87	0	0	14	53	268	586	622	357	316	40	1	0	2375
1987-88	0	0	0	18	342	589	612	425	225	83	33	0	2359
1988-89	0	0	0	0	291	581	647	449	118	23	16	0	2101
1989-90	0	0	0	70	224	519	606	449	172	12	0	0	2052
1990-91	0	0	0	23	290	761	597	247	376	57	25	0	2378
1991-92	0	0	0	77	297	552	584	308	248	12	0	0	2073
1992-93	0	0	0	16	364	655	591	410	143	32	0	0	2222
1993-94	0	0	0	33	398	573	573	737	494	166	3	0	2222

See Reference Notes on Page 6B.  
Page 5A

## COOLING DEGREE DAYS Base 65 deg. F

LAS VEGAS, NEVADA

YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC	TOTAL
1969	0	0	13	62	390	500	772	852	532	54	0	0	3175
1970	0	0	0	21	334	560	818	748	371	81	1	0	2934
1971	0	0	24	53	148	556	871	752	390	112	0	0	2906
1972	0	0	66	80	308	597	876	675	398	69	0	0	3071
1973	0	0	0	54	382	612	833	708	424	134	8	0	3155
1974	0	0	24	43	394	731	744	713	559	195	0	0	3403
1975	0	0	2	2	276	570	792	704	508	117	0	0	2973
1976	0	0	2	57	404	500	687	641	419	93	6	0	2809
1977	0	0	161	149	149	694	858	781	476	210	3	0	3332
1978	0	0	17	40	277	672	841	752	425	268	8	0	3300
1979	0	0	0	104	346	625	813	656	614	229	0	0	3387
1980	0	0	0	68	160	575	842	788	498	211	15	0	3157
1981	0	0	5	205	296	721	866	781	531	64	12	0	3481
1982	0	0	2	70	281	501	721	699	404	30	0	0	2708
1983	0	0	2	9	269	541	735	589	534	94	1	0	2783
1984	0	0	3	61	496	563	724	641	508	74	1	0	3071
1985	0	0	0	143	377	678	844	778	319	110	2	0	3251
1986	0	20	69	98	379	693	707	821	332	59	0	0	3178
1987	0	0	0	148	302	645	685	729	495	211	0	0	3215
1988	0	0	16	64	300	615	864	685	434	312	31	0	3321
1989	0	0	74	259	351	614	887	687	456	143	0	0	3482
1990	0	1	42	134	302	634	810	713	516	163	0	0	3314
1991	0	0	0	142	187	524	788	714	515	307	1	0	3089
1992	0	0	0	180	402	552	742	798	571	206	3	0	3454
1993	0	0	21	114	381	537	765	737	494	166	0	0	3215

See Reference Notes on Page 6B.  
Page 5B

## SNOWFALL (inches)

## LAS VEGAS, NEVADA

SEASON	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	TOTAL
1970-71	0.0	0.0	0.0	0.0	0.0	T	T	0.0	0.0	0.0	0.0	0.0	T
1971-72	0.0	0.0	0.0	0.0	0.0	T	0.0	0.0	0.0	0.0	0.0	0.0	T
1972-73	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	T	0.0	0.0	0.0	0.3
1973-74	0.0	0.0	0.0	0.0	0.0	0.0	13.4	0.0	0.0	0.0	0.0	0.0	13.4
1974-75	0.0	0.0	0.0	0.0	0.0	T	0.0	T	T	0.0	0.0	0.0	T
1975-76	0.0	0.0	0.0	0.0	T	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
1976-77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977-78	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978-79	0.0	0.0	0.0	0.0	0.0	T	9.9	0.3	0.0	0.0	0.0	0.0	10.2
1979-80	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980-81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981-82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982-83	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983-84	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984-85	0.0	0.0	0.0	0.0	0.0	T	0.0	T	0.0	0.0	0.0	0.0	T
1985-86	0.0	0.0	0.0	0.0	0.0	T	0.0	0.0	0.0	0.0	0.0	0.0	T
1986-87	0.0	0.0	0.0	0.0	0.0	0.0	T	0.6	0.0	0.0	0.0	0.0	0.6
1987-88	0.0	0.0	0.0	0.0	0.0	0.0	0.0	T	0.0	0.0	0.0	0.0	T
1988-89	0.0	0.0	0.0	0.0	0.0	T	0.0	0.3	0.0	0.0	0.0	0.0	0.3
1989-90	0.0	T	0.0	0.0	0.0	0.0	T	1.4	0.0	0.0	0.0	0.0	1.4
1990-91	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991-92	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	T	0.0	0.0	0.0	T
1992-93	0.0	0.0	0.0	0.0	0.0	T	0.0	0.0	0.0	0.0	0.0	0.0	T
1993-94	0.0	0.0	0.0	0.0	0.0	0.0							
Record													
Mean	0.0	T	0.0	T	0.1	0.1	1.0	0.1	T	T	0.0	0.0	1.2

See Reference Notes on Page 6B.  
Page 6A

## REFERENCE NOTES

## LAS VEGAS, NEVADA

## GENERAL

T - TRACE AMOUNT.

BLANK ENTRIES DENOTE MISSING/UNREPORTED DATA.

# INDICATES A STATION OR INSTRUMENT RELOCATION.

SEE STATION LOCATION TABLE ON PAGE 8.

## SPECIFIC

## PAGE 2

PM - INCLUDES LAST DAY OF PREVIOUS MONTH

ASOS - AUTOMATED SURFACE OBSERVING SYSTEM IN OPERATION DURING THESE MONTHS.

## PAGE 3

(a) - LENGTH OF RECORD IN YEARS, ALTHOUGH INDIVIDUAL MONTHS MAY BE MISSING.

0.5 OR \* - THE VALUE IS BETWEEN 0.0 AND 0.05

NORMALS - BASED ON THE 1961-1990 RECORD PERIOD.

EXTREMES - DATES ARE THE MOST RECENT OCCURRENCE

WIND DIR. - NUMERALS SHOW TENS OF DEGREES CLOCKWISE FROM TRUE NORTH. "00" INDICATES CALM.

RESULTANT DIRECTIONS ARE GIVEN TO WHOLE DEGREES.

BOLD VALUES INDICATE EXTREME VALUES WHICH OCCURRED AFTER THE ASOS SYSTEM WAS COMMISSIONED

## PAGE 4B

RECORD = PERIOD OF RECORD

RECORD MEAN PRECIPITATION IS THE MEAN OF ALL DAILY PRECIPITATION AMOUNTS DURING THE PERIOD OF RECORD.

RECORD MAX(MIN) TEMPERATURE IS THE MEAN OF ALL DAILY MAX(MIN) TEMPERATURES DURING THE PERIOD OF RECORD.

RECORD MEAN TEMPERATURE IS THE SUM OF THE RECORD MAX AND RECORD MIN DIVIDED BY 2.

AVERAGE TEMPERATURE IS THE SUM OF THE MEAN DAILY MAX AND MIN TEMPERATURE DIVIDED BY 2.

## EXCEPTIONS

PAGES 4A, 4B, 6A

RECORD MEANS ARE THROUGH THE CURRENT YEAR, BEGINNING IN 1937 FOR TEMPERATURE

1937 FOR PRECIPITATION

1949 FOR SNOWFALL

## LAS VEGAS, NEVADA

Las Vegas is situated near the center of a broad desert valley, which is almost surrounded by mountains ranging from 2,000 to 10,000 feet higher than the floor of the valley. This Vegas Valley, comprising about 600 square miles, runs from northwest to southeast, and slopes gradually upward on each side toward the surrounding mountains. Weather observations are taken at McCarran Airport, 7 miles south of downtown Las Vegas, and about 5 miles southwest and 300 feet higher than the lower portions of the valley. Since mountains encircle the valley, drainage winds are usually downslope toward the center, or lowest portion of the valley. This condition also affects minimum temperatures, which in lower portions of the valley can be from 15 to 25 degrees colder than recorded at the airport on clear, calm nights.

The four seasons are well defined. Summers display desert conditions, with maximum temperatures usually in the 100 degree range. The proximity of the mountains contributes to the relatively cool summer nights, with the majority of minimum temperatures in the mid 70s. During about 2 weeks almost every summer warm, moist air predominates in this area, and causes scattered thunderstorms, occasionally quite severe, together with higher than average humidity. Soil erosion, especially near the mountains and foothills surrounding the valley, is evidence of the intensity of some of the thunderstorm activity. Winters, on the whole, are mild and pleasant. Daytime temperatures average near 60 degrees with mostly clear skies. The spring and fall seasons are generally considered most ideal, although rather sharp temperature changes can occur during these months. There are very few days during the spring and fall months when outdoor activities are affected in any degree by the weather.

The Sierra Nevada Mountains of California and the Spring Mountains immediately west of the Vegas Valley, the latter rising to elevations over 10,000 feet above the valley floor, act as effective barriers to moisture moving eastward from the Pacific Ocean. It is mainly these barriers that result in a minimum of dark overcast and rainy days. Rainy days average less than one in June to three per month in the winter months. Snow rarely falls in this valley and it usually melts as it falls, or shortly thereafter. Notable exceptions have occurred.

Strong winds, associated with major storms, usually reach this valley from the southwest or through the pass from the northwest. Winds over 50 mph are infrequent but, when they do occur, are probably the most provoking of the elements experienced in the Vegas Valley, because of the blowing dust and sand associated with them.

Based on the 1951-1980 period, the average first occurrence of 32 degrees Fahrenheit in the fall is November 21 and the average last occurrence in the spring is March 7.

### Notice of Correction

Any previously received edition of the "Local Climatological Data Annual Summary for 1993" should be discarded. This revised edition contains updates to the "Normals" based upon the 1961-1990 record period as noted in the "Reference Notes" on Page 6B.

## STATION LOCATION

LAS VEGAS, NEVADA

LOCATION	OCCUPIED FROM	OCCUPIED TO	AIRLINE DISTANCES AND DIRECTIONS FROM PREVIOUS LOCATION	LATITUDE NORTH	LONGITUDE WEST	ELEVATION ABOVE										AUTOMATIC OBSERVING EQUIPMENT *	REMARKS		
						SEA LEVEL	GROUND												
							GROUND TEMPERATURE	WIND INSTRUMENTS	EXTREME THERMOMETERS	PSYCHROMETER	SUNSHINE SWITCH	TIPPING BUCKETS	RAIN GAGE	WEIGHING RAIN GAGE	8 INCH RAIN GAGE			HYGROMETER	
Western Air Express AP Water Tower Building	8/15/35	8/01/42		36° 14'	115° 02'	1876	d47	a5	5		c3	b4	a3		a - Added 12/26/36. b - Added 11/8/40. c - Added 4/29/41, removed 6/10/42. d - 30 feet to 6/21/41. Some minor relocations of instruments.				
Administration Building McCarran Field = New name for Airport.	8/01/42	12/18/48	600 ft. NW	36° 14'	115° 02'	1879	26	5	5		e4	f3	3		e - Installed 8/18/42, at 3 feet to 1/25/43. f - 4 feet to 1/25/43, removed 1/25/48. Several minor relocations of one or more instruments.				
Administration Building McCarran Field + Name transferred to new airport. Changed to McCarran International Airport in 1968.	12/18/48	2/27/76	14 mi. SW	36° 05'	115° 10'	2162	a20	5	5		3		b4	c4	a - 27 feet to 2/2/54 and 22 feet to 3/12/59. b - 5 feet to 2/2/54. c - Commissioned 2200 feet E of thermometer site 5/1/60.				
Weather Service Trailer McCarran International Airport	2/27/76	Present	1000 ft. S	36° 05'	115° 10'	2162	e20	d34	d34	336	d32	NA	d32	e4 f6	NA d - Moved to new site 9/22/76. e - commissioned 9/22/76. f - Not moved 2/27/76. - Minor adjustment & type change 01/01/86.				

## SUBSCRIPTION:

Price and ordering information available through: National Climatic Data Center, Federal Building, Asheville, North Carolina 28801.

INQUIRIES/COMMENTS CALL: (704) 271-4800

USCOM-NOAA-ASHEVILLE, N.C. - 425

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U.S. NUCLEAR REGULATORY COMMISSION

# REGULATORY GUIDE

OFFICE OF STANDARDS DEVELOPMENT

NKC 1977b

Revision 1\*  
October 1977

## REGULATORY GUIDE 1.109

### CALCULATION OF ANNUAL DOSES TO MAN FROM ROUTINE

### RELEASES OF REACTOR EFFLUENTS FOR THE PURPOSE OF EVALUATING COMPLIANCE WITH

### 10 CFR PART 50, APPENDIX I

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\*The substantial number of changes in this revision has made it impractical to indicate the changes with lines in the margin.

TABLE E-15

RECOMMENDED VALUES FOR OTHER PARAMETERS

<u>Parameter Symbol</u>	<u>Definition</u>	<u>Equation(s) Where Used</u>	<u>Values</u>	<u>Reference(s)*</u>
$f_g$	Fraction of produce ingested grown in garden of interest	14 & C-13	0.76	--
$f_L$	Fraction of leafy vegetables grown in garden of interest	14 & C-13	1.0	--
P	Effective surface density of soil (assumes a 15 cm plow layer, expressed in dry weight)	4, A-8, A-13, & C-5	240 kg/m <sup>2</sup>	10
r	Fraction of deposited activity retained on crops, leafy vegetables, or pasture grass	4, A-8, & A-13 C-5	0.25 1.0 (for iodines) 0.2 (for other particulates)	27 2, 4, 13, 28-31
$S_F$	Attenuation factor accounting for shielding provided by residential structures	8, 9, 10, 11, 12, B-6, B-7, B-8, B-9, & C-2	0.7 (for maximum individual) 0.5 (for general population)	26 26
$t_b$	Period of long-term buildup for activity in sediment or soil (nominally 15 yr)	3, 4, A-4, A-5, A-6, A-7, A-8, A-13, & C-5	$1.31 \times 10^5$ hr	--
$t_e$	Period of crop, leafy vegetable, or pasture grass exposure during growing season	4, A-8, A-13, & C-5	720 hrs (30 days, for grass-cow-milk- man pathway) 1440 hrs (60 days, for crop/vegetation- man pathway)	10 & 32
$t_f$	Transport time from animal feed-milk-man	C-10	2 days (for maximum individual) 4 days (for general population)	-- --

\* Parameter values given without references are based on staff judgments.

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PDR

**NRC 1982a**

ENVIRONMENTAL ASSESSMENT

COMBUSTION ENGINEERING, INC.  
NUCLEAR FUEL FABRICATION PLANT  
HEMATITE, MISSOURI

RELATED TO LICENSE RENEWAL OF SPECIAL  
NUCLEAR MATERIALS LICENSE NO. SNM-33  
DOCKET NO. 70-36

PREPARED BY

DIVISION OF FUEL CYCLE  
AND MATERIAL SAFETY

U. S. NUCLEAR REGULATORY COMMISSION

November 1982

NEC 19826

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# **Final Environmental Statement**

related to the operation of  
**Palo Verde Nuclear Generating Station,**  
**Units 1, 2, and 3**

Docket Nos. STN 50-528, STN 50-529, and STN 50-530

Arizona Public Service Company, et al.

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**U.S. Nuclear Regulatory  
Commission**

**Office of Nuclear Reactor Regulation**

February 1982



NRC 1983a

R-0072

NRC 1983a

NUREG/CR-1332

PART 2 of 2

Radiological Assessment: A Textbook on Environmental Dose Analysis

September 1983

U.S. DEPARTMENT OF COMMERCE  
National Technical Information Service

NTIS

# 6

## *Reference Man: A System for Internal Dose Calculations*

By J. W. POSTON\*

### 6.1 INTRODUCTION

The concept of a standard man for use in internal dose calculations originated more than 30 years ago. When early health physicists compared their dose estimates due to inhaled or ingested radioactive material (or their estimates of permissible levels in air and water), they found that agreement on basic standards for radiation protection was not good. This lack of agreement was due primarily to the use of different values of some of the biological data in their dose calculations. For this reason, a "Standard Man" was proposed. This standard man was a test individual to be used in checking on the effect of various assumptions regarding the exposure situation and in comparing dose estimates made by individual health physicists.

The first agreements on a standard man were formulated by the National Council on Radiation Protection and Measurements (NCRP) at a conference held at Chalk River in 1949 (NCRP 1950). At that time, the selected parameters were thought to be appropriate for a typical radiation worker. This first "Standard Man" consisted mainly of the specification of the masses of some important organs and tissues, specifications on intakes of air, water, and a few elements, and some data on excretion. It should be made clear that the Standard Man used by health physicists was never intended to represent man in all his aspects. The main purpose was to specify only those characteristics that were needed for purposes of dosimetry.

\*School of Nuclear Engineering and Health Physics, Georgia Institute of Technology.

# HIGHWAY CAPACITY MANUAL

Special Report 209

TRANSPORTATION RESEARCH BOARD  
National Research Council  
Washington, D.C. 1985

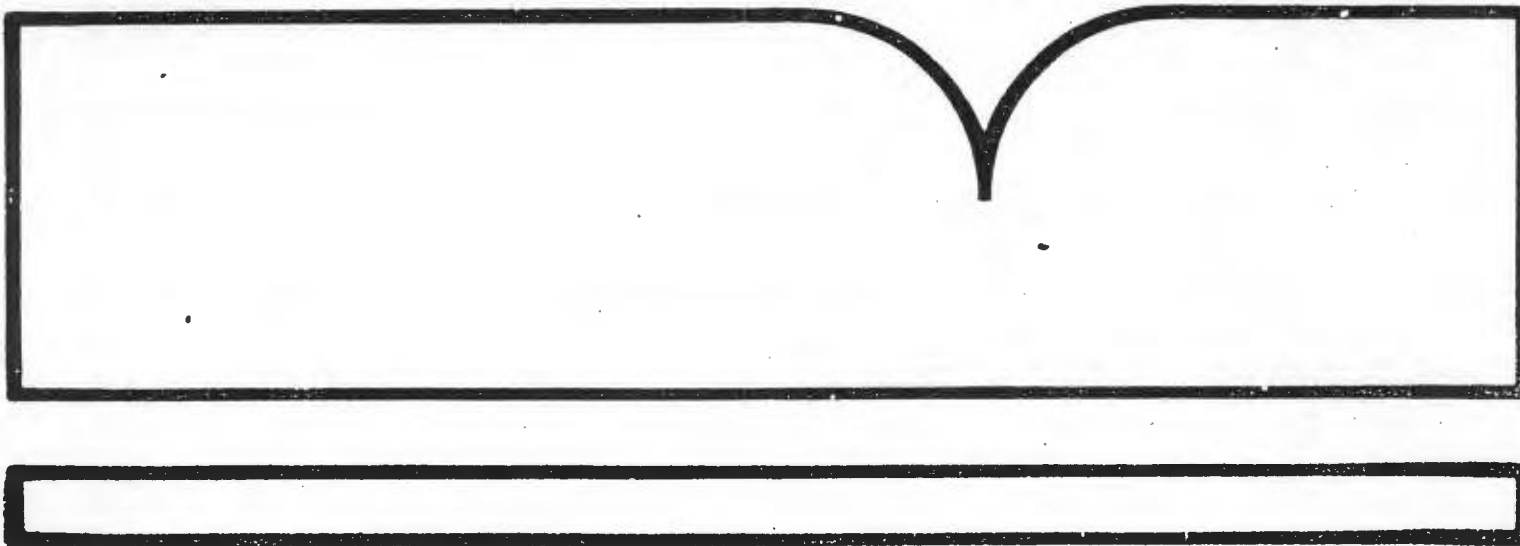
**Tornado Climatology of the  
Contiguous United States**

**Battelle Pacific Northwest Labs., Richland, WA**

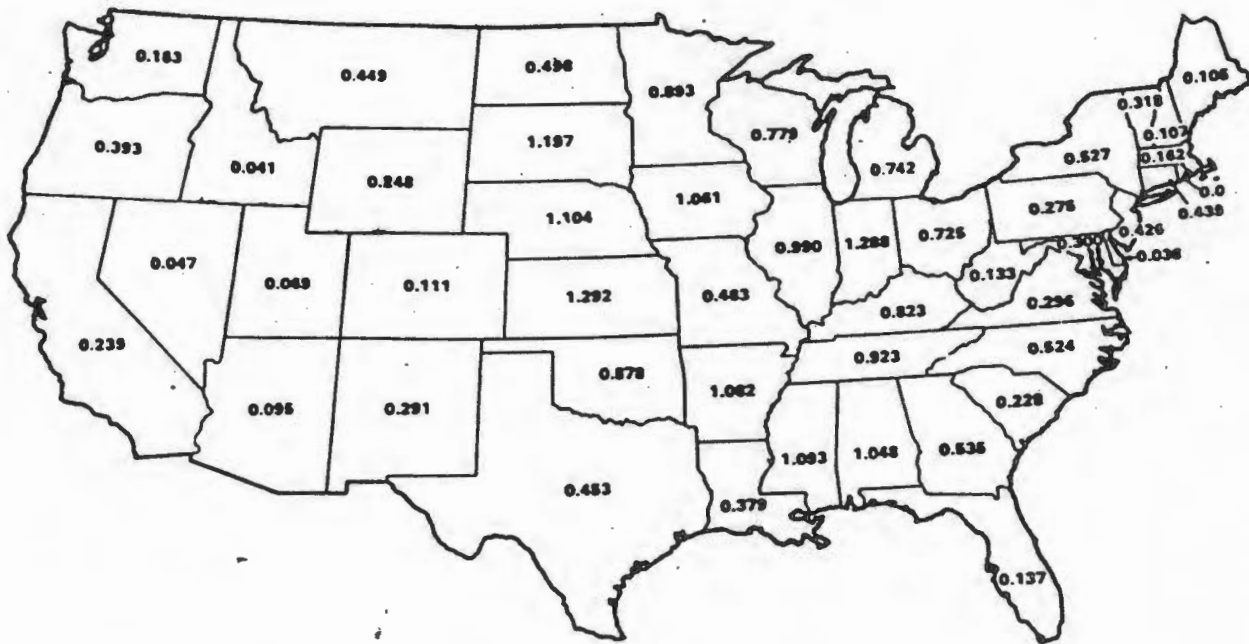
**Prepared for**

**Nuclear Regulatory Commission, Washington, DC**

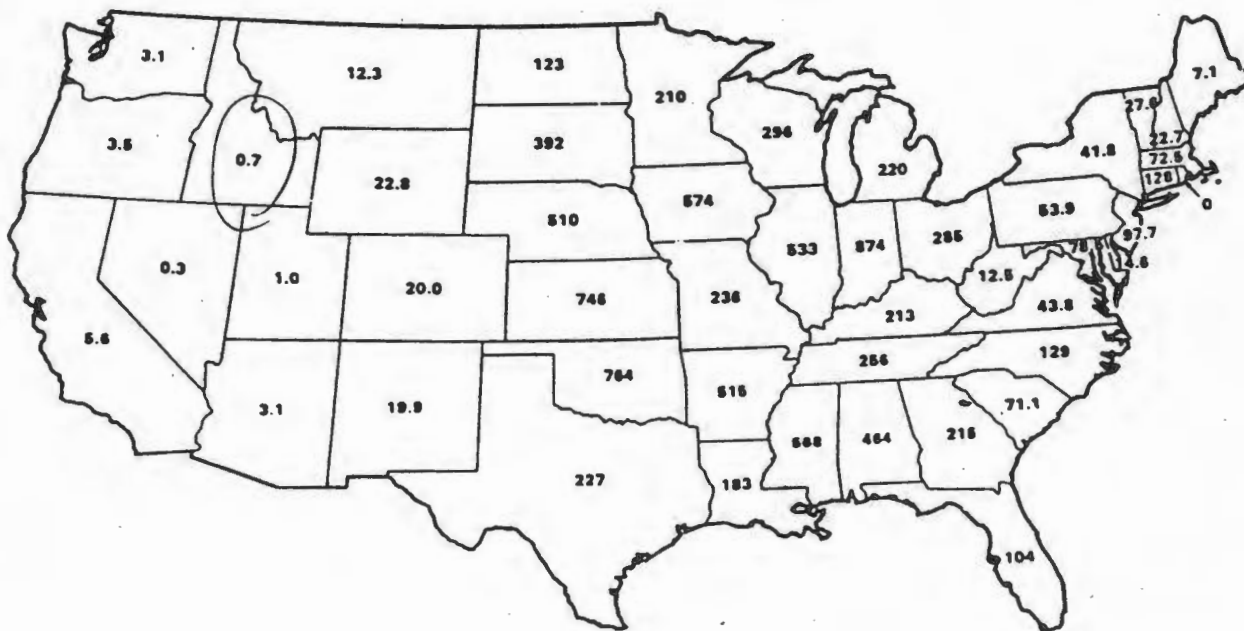
**May 86**



NRC FORM 326 (2-84) NRCM 1102 3201 3202		U.S. NUCLEAR REGULATORY COMMISSION		REPORT NUMBER - Assigned by TDC and NRC NUREG/CR-4461 PNL-5697	
BIBLIOGRAPHIC DATA SHEET				1. REPORT NUMBER - Assigned by TDC and NRC	
INSTRUCTIONS ON THE REVERSE				2. LEAVE BLANK	
3. TITLE AND SUBTITLE Tornado Climatology of the Contiguous United States				4. DATE REPORT COMPLETED MONTH: April YEAR: 1986	
5. AUTHOR(S) J. V. Ramsdell and G. L. Andrews				6. DATE REPORT ISSUED MONTH: May YEAR: 1986	
7. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) Pacific Northwest Laboratory P.O. Box 999 Richland, WA 99352				8. PROJECT/TASK/WORK UNIT NUMBER B2960	
10. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) Division of Pressurized Water Reactor Licensing-A Office of Nuclear Reactor Regulation U.S. Nuclear Regulatory Commission Washington, D.C. 20555				11. TYPE OF REPORT Technical	
12. SUPPLEMENTARY NOTES					
13. ABSTRACT (200 words or less) The characteristics of tornadoes that were reported in the contiguous United States for a period from January 1, 1954 through December 31, 1983 have been computed from data in the National Severe Storms Forecast Center tornado data base. The characteristics summarized in this report include frequency and locations of tornadoes, and their lengths, widths, and areas. Tornado strike and intensity probabilities have been estimated on a regional basis, and these estimates have been used to compute wind speeds with $10^{-5}$ , $10^{-6}$ , and $10^{-7}$ $\text{yr}^{-1}$ probabilities of occurrence. The $10^{-7}$ $\text{yr}^{-1}$ wind speeds range from below 200 mph in the western United States to about 330 mph in the vicinity of Kansas and Nebraska.  The appendices contain extensive tabulations of tornado statistics. Variations of the characteristics within the contiguous United States are presented in the summaries. Separate tabulations are provided for the contiguous United States, for each state, for each $5^\circ$ and $1^\circ$ latitude and longitude box, and for the eastern and western United States.					
14. DOCUMENT ANALYSIS - a. KEYWORDS/DESCRIPTORS Tornadoes Tornado strike probabilities Tornado intensity probability Design wind speeds Tornado dimensions b. IDENTIFIERS/OPEN ENDED TERMS				15. AVAILABILITY STATEMENT Unlimited	
				16. SECURITY CLASSIFICATION This paper: Unclassified This report: Unclassified	
				17. NUMBER OF PAGES 293	
				18. PRICE \$22.75	



**FIGURE 13.** Average Tornado Event Area (mi<sup>2</sup>) by State (1954-1983)



**FIGURE 14.** Tornado Strike Probability (yr<sup>-1</sup>) by State (1954-1983). All values have been multiplied by 10<sup>6</sup>.

R-0041

**NRC 1987b**

SHIPPING CONTAINER RESPONSE TO SEVERE  
HIGHWAY AND RAILWAY ACCIDENT CONDITIONS  
MAIN REPORT

Lawrence Livermore National Laboratory  
Livermore, CA

Feb 87

U.S. DEPARTMENT OF COMMERCE  
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NUREG-1437

Vol. 1

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# Generic Environmental Impact Statement for License Renewal of Nuclear Plants

Main Report

Draft Report for Comment

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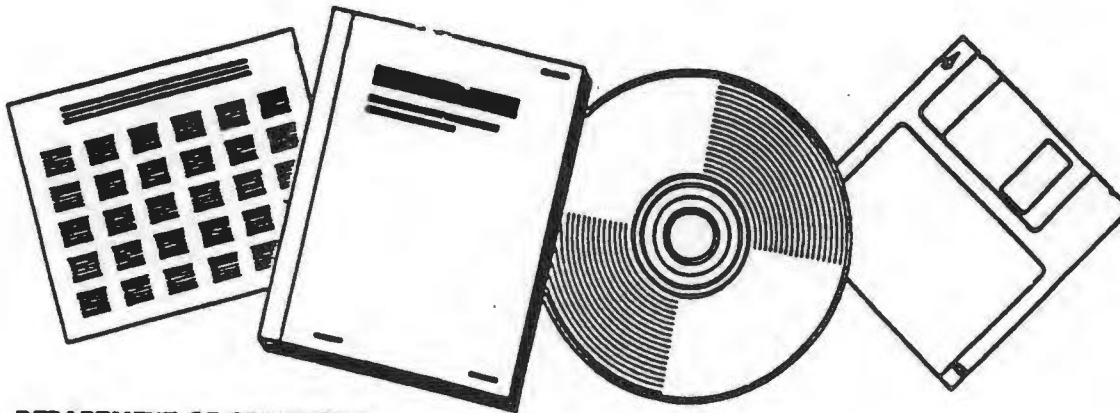
NUREG-0713-V15

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# **OCCUPATIONAL RADIATION EXPOSURE AT COMMERCIAL NUCLEAR POWER REACTORS AND OTHER FACILITIES, 1993. TWENTY-SIXTH ANNUAL REPORT**

(U.S.) NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC

JAN 95



U.S. DEPARTMENT OF COMMERCE  
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NUREG-0713  
Vol. 15

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# Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 1993

Twenty-Sixth Annual Report

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**U.S. Nuclear Regulatory Commission**

**Office of Nuclear Regulatory Research**

C. T. Raddatz, D. Hagemeyer



# V

## APPENDIX A (cont.)

### FUEL FABRICATORS AND PROCESSORS -1993

Licensee Name	Program Code 21210	License Number	Total Number of Individuals Monitored	Workers with Measurable Exposure	Collective Dose (person-cSv)	Average Max. Dose (cSv or rem)
NUCLEAR FUEL SERVICES, INC.		SH84-0124	3,373	323	78,880	0.24
WESTINGHOUSE ELECTRIC CORP.		SH84-1107	613	805	87,530	0.19
SIEMENS POWER CORP.		SH84-1227	638	485	62,800	0.13
COMBUSTION ENGINEERING, INC.		SH84-1087	186	84	6,960	0.12
B&W FUEL CO.		SH84-1188	204	88	10,180	0.11
GENERAL ELECTRIC CO.		SH84-1087	1,078	378	35,180	0.09
GENERAL ATOMICS		SH84-0886	827	88	8,900	0.08
BABCOCK & WILCOX CO.		SH84-0042	2,829	681	41,080	0.08
			9,849	2,611	338,670	0.13

### INDEPENDENT SPENT FUEL STORAGE INSTALLATION - 1993

Licensee Name	Program Code 22380	License Number	Total Number of Individuals Monitored	Workers with Measurable Exposure	Collective Dose (person-cSv)	Average Max. Dose (cSv or rem)
GENERAL ELECTRIC CO.		SH84-2500	122	82	13,960	0.28
CAROLINA POWER & LIGHT CO.		SH84-2502	13	0	0.000	0.00
PUBLIC SERV. CO. OF CO*		SH84-2504	0	0	0.000	0.00
VIRGINIA ELECTRIC POWER**		SH84-2501	0	0	0.000	0.00
BALTIMORE GAS & ELECTRIC CO.***		SH84-2505	0	0	0.000	0.00
			135	82	13,960	0.28

\* Reported with PL St. Vrain

\*\* Reported with Surry 1,2 DPR-32, 37

\*\*\* Reported with Calvert Cliffs 1,2 DPR-53, 69

### LOW LEVEL WASTE DISPOSAL FACILITIES - 1993

Licensee Name	Program Code 6E231	License Number	Total Number of Individuals Monitored	Workers with Measurable Exposure	Collective Dose (person-cSv)	Average Max. Dose (cSv or rem)
CHEM-NUCLEAR SYSTEMS, INC.		12-13536-01	146	58	19,020	0.32
U. S. ECOLOGY, INC.		16-19204-01	286	17	1,860	0.11
			432	75	20,870	0.27

*NV County 1995a:1*

S&D

NTS LAND USE PLANS, POLICIES AND CONTROLS  
November 27, 1995

Ron Williams  
Planning Director  
Nye County, NV (Tonapah)  
[REDACTED]

Nye County Comprehensive Plan (i.e., master plan) adopted April 5, 1995

Comprehensive plan is a policy document (goals and objectives, not a land use plan)

Current comprehensive plan makes no mention of NTS

The comprehensive plan sets up for Nye County to write area plans (land use plan) and zoning ordinance. Anticipate beginning with area plan (for unincorporated town of Pahrump) early next year.

No planning commission in Nye County--Board of County Commissioners acts as Nye County planning commission--no Nye County municipalities plan, no planning at the state level. Not state mandate to plan--state enabling acts allow counties, municipalities to plan if they so choose. State only mandates that if you have comprehensive plan, zoning must conform to it.

A policy of the current comprehensive plan leads Williams to believe that the forthcoming comprehensive land use plan will designate the entire Nye County as "Open Use". Then, if a town or an area develops a comprehensive plan and zoning ordinance, the designation would be revised in accordance with their adopted plan.

**NT DOE 1983a**

NVO-269  
(DE84002818)  
Distribution Category UC-70

ATMOSPHERIC OVERVIEW FOR THE NEVADA NUCLEAR WASTE STORAGE  
INVESTIGATIONS, NEVADA TEST SITE, NYE COUNTY, NEVADA\*

John L. Bowen  
and  
Richard T. Egami  
Desert Research Institute  
University of Nevada System

NOVEMBER 1983

UNITED STATES DEPARTMENT  
OF ENERGY  
NEVADA OPERATIONS OFFICE  
LAS VEGAS, NEVADA

\*This work was performed by the Desert Research Institute for the U. S.  
Department of Energy under modification A001 to contract DE-AC08-80NV10162.

*Dup 0033*

sightings of tornadoes, water spouts and funnel clouds in Nevada from 1947 to 1974. Of the 51 sightings, the southern part of the state had four tornadoes, one water spout, and six funnel clouds. It is likely that there have been more occurrences which have not been seen due to the sparseness of population. Even so, the chance of a tornado at NTS is probably small, since meteorological conditions conducive to tornado formation (Fujitu, 1973) do not occur often over southern Nevada. McDonald et al. (1975) have determined the probabilities for tornadoes and straight winds at NTS. For a straight wind, exceedances of 100 mph and 300 mph have probabilities of  $1.0 \times 10^{-3}$  and  $4.0 \times 10^{-8}$  respectively. The same probabilities for tornado winds are  $5.9 \times 10^{-7}$  and  $5.5 \times 10^{-9}$ .

## 2. Precipitation Extremes

Large amounts of precipitation can occur in the presence of thunderstorms. The ground cannot absorb a large amount of water which leads to flash flooding in some low lying areas. The presence of dry stream beds or washes on NTS attests to the fact that flash floods have occurred in the past. The amount of rain that a particular area can handle is dependent on the terrain and soil type. A steep area will have faster run off than gradual terrain. Some soils are more porous to water than others although, in most cases, heavy precipitation would have little time to sink into the soil. To determine the actual flooding potential of NTS, one would have to look at a specific site with some representative precipitation rate and compute the amount of flooding. This has been done for the Tonopah Wash area by Christensen and Spahr (1980). As with the normal amounts of precipitation, the greatest 24-hour values also have an altitude dependence. Thompson et al. (1970) have determined the greatest 24-hour precipitation for various return periods for precipitation stations in Nevada.

Table 7 shows data from stations around NTS. The Beatty results should be indicative of the lower areas of the southwest NTS with Goldfield being more representative of the higher elevations. In most cases thunderstorm precipitation will fall for much less than 24 hours putting the amount of rain in Table 7 in the ground in closer to an hour. This higher rainfall rate is even more conducive to flash floods.

### 3. Lightning and Thunderstorms

Lightning is associated with thunderstorms and can occur within clouds or between the clouds and the ground. The latter is obviously more harmful to surface operations of a waste repository. Cloud to ground lightning can occur more readily at an exposed location, such as a ridge or a tower. Quiring (1972) has compiled a set of lightning and thunderstorm statistics for Yucca Flat. July and August had the most lightning with the time of highest frequency of lightning in the early evening. This time is biased because observations of lightning are easier at night. The presence of cumulonimbus clouds on thunderstorm days may be a better indicator of lightning. These reach a maximum frequency in mid-afternoon. Thunderstorm days occur on 16% of the days in July and August and 5% of the days for the entire year. Precautions should be taken to guard against lightning damage.

### 4. Temperature Extremes

Desert regions of southern Nevada have extremely high temperatures during summer. The climatological summary for Las Vegas, shown in Table 3 above, has daily maximum temperatures greater than 100°F for July and August and extremes as high as 117°F. Exposure to these high temperatures along with the low relative humidities can affect personnel and machinery if precautions are not taken.

TABLE 7

## GREATEST 24-HOUR PRECIPITATION IN INCHES

<u>Station</u>	<u>Elevation</u> <u>m</u>	<u>RETURN PERIOD (years)</u>					
		<u>2</u>	<u>5</u>	<u>10</u>	<u>25</u>	<u>50</u>	<u>100</u>
Las Vegas	659	0.84	1.33	1.65	2.07	2.39	2.69
Boulder City	770	0.90	1.34	1.62	2.01	2.27	2.52
Beatty	1010	0.88	1.29	1.57	1.91	2.17	2.43
Caliente	1342	1.11	1.56	1.84	2.25	2.52	2.81
Goldfield	1734	1.03	1.60	1.99	2.46	2.84	3.19
Pioche	1862	1.46	2.06	2.46	2.96	3.37	3.73
Adaven	1905	1.38	1.86	2.16	2.58	2.85	3.15

After Thomas et al. (1970)

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**Nuclear Waste Policy Act**  
(Section 112)

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# Environmental Assessment

*Yucca Mountain Site, Nevada Research  
and Development Area, Nevada*

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**Volume I**

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**May 1986**

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**U.S. Department of Energy**  
Office of Civilian Radioactive Waste Management  
Washington, DC 20585

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**TRITIUM SUPPLY AND RECYCLING  
PROGRAMMATIC ENVIRONMENTAL IMPACT  
STATEMENT**

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**U.S. Department of Energy  
Washington, DC 20585**

**Environment, Safety and Health  
Office of Environmental Audit**



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**Environmental Survey  
Preliminary Report**

**Nevada Test Site  
Mercury, Nevada**

**April 1988**

PREFACE  
TO  
THE DEPARTMENT OF ENERGY  
NEVADA TEST SITE  
ENVIRONMENTAL SURVEY PRELIMINARY REPORT

This report contains the preliminary findings based on the first phase of the Environmental Survey at the Department of Energy (DOE) Nevada Test Site (NTS), located at Mercury, Nevada. The Survey is being conducted by DOE's Office of Environment, Safety and Health.

The NTS Survey is a portion of the larger, comprehensive DOE Environmental Survey encompassing all major operating facilities of DOE. The DOE Environmental Survey is one of a series of initiatives announced on September 18, 1985, by Secretary of Energy, John S. Herrington, to strengthen the environmental, safety, and health programs and activities within DOE. The purpose of the Environmental Survey is to identify, via a "no-fault" baseline Survey of all the Department's major operating facilities, environmental problems and areas of environmental risk. The identified problem areas will be prioritized on a Department-wide basis in order of importance in 1989.

The findings in this report are subject to modification based on the results from the Sampling and Analysis Phase of the Survey. The findings are also subject to modification based on comments from the Nevada Operations Office concerning their technical accuracy. The modified preliminary findings and any other appropriate changes will be incorporated into an Interim Report. The Interim Report will serve as the site-specific source of environmental information generated by the Survey, and ultimately as the primary source of information for the DOE-wide prioritization of environmental problems in the Survey Summary Report.

April 1988  
Washington, D.C.

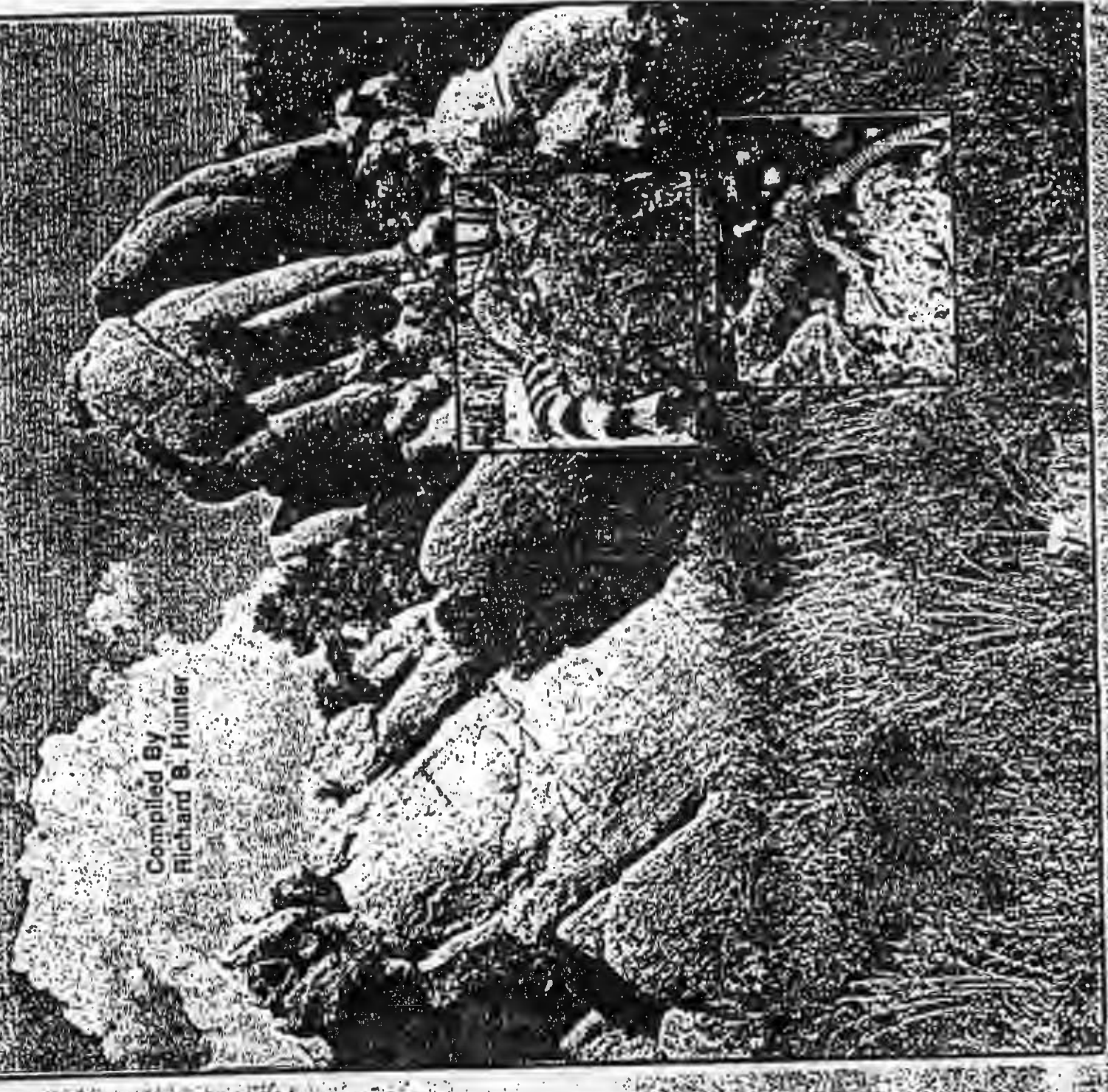
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DATE/NO/1988

DOENV106 0 29

# STATUS OF THE FLORA AND FAUNA ON THE NEVADA TEST SITE, 1988

Compiled By  
Richard B. Hunter



# SECTION 1

## EXTENT OF LAND DISTURBANCE ON THE NEVADA TEST SITE

by  
Richard B. Hunter and Phillip A. Medica

The Nevada Test Site comprises approximately 3600 square kilometers divided into 27 geographical areas (Figure 1.1) that range in size from 13 km<sup>2</sup> (Area 23, Mercury) to 649 km<sup>2</sup> (Area 25, Nevada Research and Development Area, NRDA).

The types of disturbance considered here include burned areas resulting from lightning-initiated fires or man-caused fires; blast zones from nuclear tests radex areas (radiation exclusion areas contaminated by radiation from above-ground nuclear testing); alpha radex areas; waste disposal areas; subsidence craters, drill pads and cable runs; base camp facilities and staging areas; roads (paved and unpaved), pre-emplacement test holes; and drill pads and tests which have not cratered. The area estimates (Table 1.1) are approximations based upon maps and best-guess estimates by personnel who are familiar with the NTS. Fires were approximated by NTS Fire Chief Ray Gudeman, at the time of each fire. Though crude in accuracy, these estimates represent the best available figures as of January 1988. Table 1.1 has associated notes that list the sources (maps, guesses, and measurements made from maps) for the area estimations.

Burned areas comprise the largest single disturbance on the NTS, covering 4.3% of the total NTS geographical area. The available records only included data from 1978 through 1987. The majority of the fires were in Areas 14, 16, 25, 29 and 30 and in the Mid Valley, Shoshone Mountain and Buckboard Mesa region, which burned nearly 15,600 ha blast zones, at 1. Altogether, radex areas amount to 0.8% of the entire area of the NTS; craters and associated activities, 0.6%; and roads, 0.4%. Most radex areas, and many craters and drill pads, are within areas whose vegetation was removed by atmospheric nuclear weapons tests in the 1950s (blast zones).

Virtually all of the NTS has been impacted by introduced plants (although this is difficult to document in hectares). These introduced plants include annual grasses (*Bromus rubens*, *Bromus tectorum*, and *Schismus arabicus*), and weedy ephemerals (*Erodium cicutarium*, *Salsola australis*, and *Sisymbrium altissimum*). The introduced species may considerably change the environment, as they often occur in dense stands. Small portions of the NTS may be affected by introduced mammals (horses) and birds (chukars). Horses may significantly impact areas around springs and other water sources.

Gophers create large bare patches in the Mojave Desert sections of the NTS. A crude estimate of the total area of these is 400 ha, which would be largely in Areas 5, 22 and 25.

The area most heavily impacted by weapons testing is the Yucca Flat valley floor, composed of approximately 57,000 ha. Of that area, about 5724 ha (10%) have been blasted free of vegetation, 2039 ha (3.6%) are affected by subsidence craters and drill pads, and 1403 ha (2.5%) are contaminated by radionuclides. Since many of these disturbances overlap, the total percent of the valley floor disturbed by testing must be somewhat less than 15%.

000700700

11. 6%


**Table 1.1 (notes)**

<b>Area:</b>	Area designation on NTS maps.
<b>Total area:</b>	Based upon independent measurements on the NTS Map.
<b>Blast zones:</b>	Based upon map in BYU report, Allred et al. 1963 <sup>2</sup>
<b>Radex areas:</b>	Based upon Radsafe Map, June 1984.
<b>Alpha radex areas:</b>	Based upon Radsafe Map, June 1984. (Area 11 area estimate is based upon the area beyond Barricade 11-2R).
<b>Waste radex areas:</b>	Based upon Radsafe Map, June 1984. Some radex areas may have been consolidated by now.
<b>Tunnel radex areas:</b>	Includes tailings, ponds, etc., in and around portals.
<b>Craters:</b>	Includes only the area within the crater (based upon approximations from NTS planning maps).
<b>Drill pads at craters:</b>	An estimate of the disturbed area around the crater. This estimate was usually made by simply doubling the area of the crater. This is a rough approximation.
<b>Used and unused drill pads:</b>	These include an estimate of one hectare at each mapped pad.
<b>Estimated area of facilities:</b>	Best guess by Medica and Hunter.
<b>Burned Acres:</b>	Fires since 1978; area estimated by Chief Gudeman, through January 1988.
<b>Roads (Paved):</b> <b>(Dirt):</b>	Measured on maps. Length X (18.3 m width). Measured on maps. Length X (6.10 m width). Many small dirt roads are not on the maps used. Skid lanes are not included. We consider this an underestimate.
<b>Waste Mgt. areas:</b>	Estimates by Neagle and Straight. January 1988.

---

<sup>2</sup>All calculations are based upon measurements made from maps, and therefore should be considered crude estimates.

<sup>2</sup>Allred, D. M., D E. Beck, and C. D. Jorgensen. 1963. Biotic Communities of the Nevada Test Site. Brigham Young University Science Bulletin, Biological Series 2(2). 52 pp.

 DESERT RESEARCH INSTITUTE  
UNIVERSITY OF NEVADA SYSTEM

DRAFT

CLASSIFICATION OF GROUNDWATER  
AT THE NEVADA TEST SITE

by  
Jenny B. Chapman

DRAFT

January 1989

WATER RESOURCES CENTER

Publication # 45069

CLASSIFICATION OF GROUNDWATER  
AT THE NEVADA TEST SITE

by

Jenny B. Chapman  
Water Resources Center  
Desert Research Institute  
University of Nevada System  
Las Vegas, Nevada

DRAFT

Change

"(Winograd and Thordarson, 1975)"

to "(WT 75)" after

page 5, but leave

Prepared for  
the U.S. Department of Energy  
Nevada Operations Office  
Las Vegas, Nevada  
under Contract DE-AC08-85NV10384

"Winograd and Thordarson (1975)"

at this

DRAFT

January 1989

NTT DOE 1991/6

DOE/NV/10630-20  
Volume I

DOE/NV/10630-20  
Volume I

**U.S. DEPARTMENT OF ENERGY  
NEVADA OPERATIONS OFFICE  
ANNUAL SITE ENVIRONMENTAL  
REPORT - 1990**

**Volume I**

**TRITIUM SUPPLY AND RECYCLING  
PROGRAMMATIC ENVIRONMENTAL IMPACT  
STATEMENT**

Editors: Elizabeth M. Mc

September 1991

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prepared by:

Reynolds Electrical & Engineering Co., Inc.  
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# U.S. DEPARTMENT OF ENERGY NEVADA FIELD OFFICE ANNUAL SITE ENVIRONMENTAL REPORT - 1991

Volume I

Editors: Stuart C. Black, Alan R. Latham and Yvonne E. Townsend

Prepared by:

September 1992

Reynolds Electrical & Engineering Co., Inc.  
Post Office Box 98521  
Las Vegas, Nevada 89193-3521

## TRITIUM SUPPLY AND RECYCLING PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

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DRAFT

# 1992 Annual Report on Waste Generation and Waste Minimization Progress

as Required by SEN-37-92

and

DOE Order 5400.1

## TRITIUM SUPPLY AND RECYCLING PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

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Prepared for:

United States Department of Energy

Prepared by:

Reynolds Electrical and Engineering Co., Inc.  
Waste Minimization Project Office

DRAFT

January 19, 1993



Nevada Test Site

01/19/91

## II. General Site Information

### General Site Mission

Nuclear and limited non-nuclear testing, storage and waste disposal facilities for TRU and mixed wastes

### Mailing Address

Reynolds Electrical & Engineering Co  
P. O. Box 98521 Las Vegas, NV 89193-8521

Program Secretarial Officers (PSOs) which are currently involved in activities at this site are as follows:

#### Lead PSO



#### Additional PSOs

AD	CE	DP	EM	ER	FC	NE	NP	RW
			X					

#### Point of Contact (DOE)

A. P. Colarusso  
Nevada Field Office  
Phone: (702)295-1218  
Fax: (702)295-1810

#### Point of Contact (Contractor)

T. S. Holmes  
Reynolds Electrical & Engineering Co.  
Phone: (702)295-0656  
Fax: (702)295-6366

#### Site Size (acres)

864000

#### Number of Employees

##### DOE

0

##### Contractor

3691

NT DOE 1973d

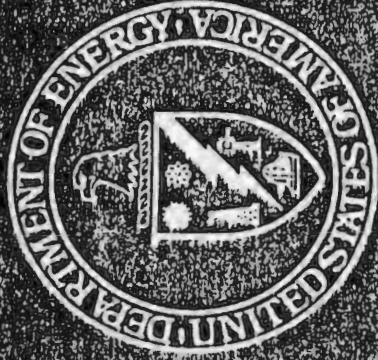
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UC-900

Rev. 7-1992

# United States Department of Energy

## Nevada Field Office



### Environmental Restoration and Waste Management

## SITE SPECIFIC PLAN

Fiscal Years 1994-1998



### TRITIUM SUPPLY AND RECYCLING PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

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**U.S. DEPARTMENT OF ENERGY  
ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT  
SITE SPECIFIC PLAN**

The U.S. Department of Energy (DOE) understands that cleaning up the Nation's nuclear-related sites and facilities affects many different segments of the public, ranging from communities near DOE facilities, to engineers concerned with developing new technologies to clean-up the environment. In an effort to make the Environmental Restoration and Waste Management Site Specific Plan more responsive to your concerns, DOE invites your comments on the plan. The Site Specific Plan was released for a 60-day public comment period that ends in May 1993.

Your comments will be taken into consideration in the development of next year's plan. Please mail your comments to the address below. You may submit as many pages as you like. Your input is greatly appreciated.

Office of External Affairs (ERWM)  
DOE Nevada Field Office  
P.O. Box 98518  
Las Vegas, Nevada 89193-8518  
Attention: Darwin Morgan

Comments: \_\_\_\_\_

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DOE/NV/10630-66

Volume I

UC-600

# ANNUAL SITE ENVIRONMENTAL REPORT - 1992 VOLUME I

## TRITIUM SUPPLY AND RECYCLING PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

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NEVADA TEST SITE

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**U.S. DEPARTMENT OF ENERGY  
NEVADA OPERATIONS OFFICE  
ANNUAL SITE ENVIRONMENTAL  
REPORT - 1992**

**VOLUME I**

Editors: Stuart C. Black, Alan R. Latham and Yvonne E. Townsend

September 1993

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Nevada Operations Office

Prepared by:

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Post Office Box 98521  
Las Vegas, Nevada 89193-8521

**NT DOE 1994b**

DOE/NV/11432-123  
Volume I  
UC-600

**U.S. DEPARTMENT OF ENERGY  
NEVADA OPERATIONS OFFICE  
ANNUAL SITE ENVIRONMENTAL  
REPORT - 1993**

**VOLUME I**

Editors: Stuart C. Black, Wayne M. Glines and Yvonne E. Townsend  
Graphics Artist: Angela L. McCurdy

September 1994

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# Nevada Test Site Solar Feasibility Study

Prepared for:

U.S. Department of Energy  
Nevada Operations Office  
PO Box 98518  
Las Vegas, NV 89193-8518

and

U.S. Department of Energy  
Office of Energy Efficiency and Renewable Energy  
Office of Solar Energy Conversion  
1000 Independence Avenue, SW  
Washington, DC 20585

Prepared by:

George Sterzinger  
Economics, Environment and Regulation  
1615 M St. NW  
Washington, DC 20036

and

DynCorp • Meridian  
4300 King St.  
Alexandria, VA 22302



**NT DOE 1995j**

DOE/NV/11432-177  
UC-600

DOE/NV/11432-177  
UC-600

**1994 BASELINE BIOLOGICAL  
STUDIES FOR THE DEVICE ASSEMBLY  
FACILITY AT THE NEVADA  
TEST SITE**

**By:**

**Bruce D. Woodward  
Richard B. Hunter  
Paul D. Greger  
Mary B. Saethre**

**February 1995**

**Work Performed Under  
Contract No. DE-AC08-94NV11432**

**Prepared by:**

**Reynolds Electrical & Engineering Co., Inc.  
Post Office Box 98521  
Las Vegas, Nevada 89193-8521**



# ENDANGERED SPECIES

## Technical Bulletin

U.S. Department of the Interior  
Fish and Wildlife Service

### Ash Meadows and Recovery Efforts for its Endangered Aquatic Species

Linda L. Hallock  
National Fisheries Research Center-Seattle  
Reno, Nevada, Substation

Ash Meadows is a wetland ecosystem in an unlikely setting, the otherwise parched Mojave Desert, about 90 miles (144 kilometers) northwest of Las Vegas, Nevada. Within a region where the annual rainfall averages less than 2.75 inches (7 centimeters) and the evaporation rate exceeds 98 inches (249 cm) annually, Ash Meadows contains approximately 30 seeps and springs with associated streambeds and terminal marshes, formed where an extensive aquifer surfaces.

This unusual ecosystem is a remnant of wetter times in the early Pleistocene Epoch, when the region was crossed by an interconnecting system of lakes and rivers. Many of the unique species and subspecies now found at Ash Meadows evolved from relict populations that became isolated as the area turned drier. Because of their restricted range and threats to their habitat, 12 plants and animals in this area have been listed as Endangered or Threatened (see *Bulletin* Vol. VII, No. 6; Vol. VIII, No. 9; Vol. X, No. 6), and another 20 are candidates for listing. All of these, except for four plants, are found only at Ash Meadows, giving this ecosystem the highest known concentration of endemic taxa in the continental United States. Endangered aquatic fauna include the Ash Meadows naucorid (*Ambrysus amargosus*), an insect, and four fishes: the Ash Meadows Amar-

(continued on page 4)

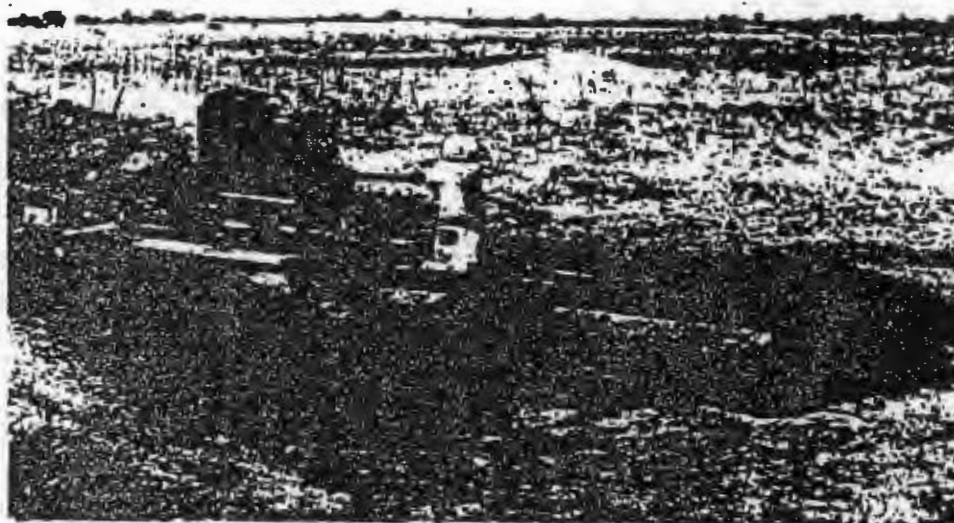


photo by James Yodanis



photo by Donald W. Smith

Two views of Jack Rabbit Spring in Ash Meadows. The top photo, taken in the 1970's, illustrates the results of over-pumping, which had obvious effects on the spring's aquatic wildlife. The bottom photo, taken in 1983 from a different angle, shows that some aquatic systems can be rehabilitated even after serious environmental damage.

## Ash Meadows

(continued from page 1)

gosa pupfish (*Cyprinodon nevadensis mionectes*), Warm Springs pupfish (*Cyprinodon nevadensis pectoralis*), Devils Hole pupfish (*Cyprinodon diabolis*), and Ash Meadows speckled dace (*Rhinichthys osculus nevadensis*). A fifth fish, the Ash Meadows poolfish (*Empetrichthys merriami*), became extinct within the past 40 years.

### Threats to the Habitat

Ash Meadows has been used by humans since prehistoric times. The water, food, and shelter attracted Indians to this otherwise harsh area. With

starchood in 1864, some springs and streamside land passed into private ownership; however, the agricultural use at that time was mainly at a subsistence level and had limited effects on the environment. The first significant impact occurred in the 1960's when Carson Slough, the largest marsh in southern Nevada, was mined for peat. Approximately 2,000 acres (810 hectares) of emergent wetland fish and migratory bird habitat were destroyed.

In the late 1960's, Spring Meadows Ranch, Inc., started raising cattle, alfalfa, and various other crops on 18,000 acres (7,290 ha) in the Ash Meadows area. Thousands of acres

were cleared, leveled, planted, and irrigated. Springheads were excavated and streambeds channelized, some lined with concrete. Extensive pumping of the aquifer lowered the water table and reduced spring discharge, thus disrupting or even eliminating some spring ecosystems. Much vital aquatic habitat was destroyed, and native fishes were eliminated from some spring systems. For example, the speckled dace is now estimated to survive in only 1 acre (0.4 ha) of habitat compared with the nearly 600 acres (243 ha) it occupied before 1950.

These problems were compounded when a number of exotic species re-

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## Ash Meadows

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In Ash Meadows began competing with, and preying upon, native species. Mosquitofish (*Gambusia affinis*) and sailfin mollies (*Poecilia latipinna*) are now common throughout the area. Non-native crayfish (*Procambarus clarkii*), bullfrogs (*Rana catesbeiana*), and largemouth bass (*Micropterus salmoides*) also are present in various systems.

By 1969, the water level in Devil's Hole had fallen to a point threatening its most well-known resident, the Devils Hole pupfish, with imminent extinction. Negotiations over water use failed and the ensuing litigation went to the U.S. Supreme Court, resulting in a landmark decision in 1976 limiting the amount of water that could be pumped from the basin supplying Devil's Hole. The species' entire habitat is now restricted to a 180 square foot (16.7 square meter) submerged rock shelf.

After the Supreme Court decision, Spring Meadows Ranch determined that the amount of water it could legally remove was insufficient for its plans and offered to sell the land to the U.S. Fish and Wildlife Service. The Service declined the offer, and between 1977 and 1980 the land was purchased by Preferred Equities Corporation, a real estate development company.

Preferred Equities planned to develop the area as Calvada Lakes, a residential, recreational, and industrial complex with an anticipated population of more than 50,000. Further alteration of the springs and outflows to facilitate irrigation and/or construct municipal parks destroyed additional aquatic habitat and led to an emergency rule to list the Ash Meadows speckled dace and Ash Meadows Amargosa pupfish as Endangered (see Bulletin Vol. VII, No. 6). Due to the protection extended by the Endangered Species Act, the developer was then prohibited from taking actions that would harm the listed fish.

## The Ash Meadows National Wildlife Refuge

In 1984, Preferred Equities sold 12,654 acres (5,125 ha) in the heart of Ash Meadows to The Nature Conservancy (see Bulletin Vol. IX, No. 3). The Conservancy promptly resold this land to the Fish and Wildlife Service, which used it to establish the Ash Meadows National Wildlife Refuge. With the inclusion of adjacent public lands administered by the Bureau of Land Management and future acquisitions of private lands as they become available, an Area of Management Concern of some 23,000 acres (9,315 ha) is envisioned. Devil's Hole, though within the Ash Meadows ecosystem, is not part of the refuge. This submerged limestone cavern entrance and the surrounding 40 acres (16.2 ha) have been managed by the National Park Service as an isolated segment of Death Valley National Monument since 1952.

The refuge is being managed in accordance with the Ash Meadows Species Recovery Plan, which was approved by the Fish and Wildlife Service in September 1990. Ultimately, the goal is to restore the ecosystem to the point that all of its native plants and animals, including the Endangered, Threatened, and listing candidate species, are secure and self-sustaining. Work toward this goal has already begun. For example, natural flows have been restored at some habitats, such as Jack Rabbit Spring, where the Ash Meadows speckled dace and Ash Meadows Amargosa pupfish are now reestablished. The Bureau of Land Management fenced this spring to allow recovery of vegetation and promote natural channel development.

However, very little is known about the habitat requirements and preferences of the native species or of the competing exotics. Additional information is needed to guide further rehabilitation efforts. At this time, management is focusing on preventing further habitat degradation. After

more research, efforts at restoration can be safely undertaken. A research team of biologists from the Reno Field Station of the National Fisheries Research Center-Seattle, Ash Meadows National Wildlife Refuge, and the Nevada Department of Wildlife has been assembled to conduct habitat restoration studies for the area's aquatic wildlife.

The currently available fish habitat includes barren concrete ditches, irrigation ditches with gravel bottoms and straight earthen sides, dense bulrush marshes, overgrown stream beds, a few remaining natural springs, and open pools. Stream size varies from barely 6 inches (15 cm) wide and 3 inches (8 cm) deep to more than 15 feet (5 m) wide and 3 feet (1 m) deep. The springheads vary from springs with no pool and outflows of less than 1 gallon per minute (5 liters per minute) to large excavated pools 40 feet (12 m) in diameter with outflows of more than 3,500 gpm (13,265 lpm). Water temperatures vary seasonally from freezing (in distal outflows, during winter) up to 88°F (31°C) at springheads. Current research includes investigations into population dynamics to determine seasonal use of the available habitats by species and age class.

Studies on the aquatic wildlife of Ash Meadows are not limited to fishes. The Ash Meadows naucorid is an insect about one-quarter of an inch (0.5 millimeters) long found in the gravel of riffles. Its distribution, life history, and habitat requirements are virtually unknown. Recent work by the research team has shown the naucorid to be more widely spread than previously believed. Investigation into its distribution, life history, and habitat requirements continues.

Once the habitat requirements and preferences of Ash Meadows' native aquatic animals are known, restoration efforts can accelerate. These efforts may incorporate habitat rehabilitation and management strategies

(continued on page 6)

## to Endangered



**African elephant bulls sparring**

A proposed rule to reclassify the African elephant (*Loxodonta africana*) under the Endangered Species Act from Threatened to the more critical category of Endangered was published March 18 by the U.S. Fish and Wildlife Service. If the rule is approved as proposed, it will apply to all populations except those in Botswana, Zimbabwe, and South Africa, where the species will retain its current classification of Threatened.

African elephant numbers are believed to have fallen more than 50 percent over the past decade, and the rate of loss continues at about 8 percent per year. In 1979, the total elephant population in Africa was approximately 1.3 million, but it is estimated that fewer than 600,000 remain. The intensive illegal killing of elephants to supply the ivory market is the most immediate threat. Over the long term, however, the species also faces habitat destruction and fragmentation due to agricultural development, urbanization, and desertification.

Concern for the African elephant has been building for some time. It

was first given Endangered Species Act protection in 1978, when the species was listed as Threatened. This action, along with placing the elephant on Appendix II of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), regulated the importation of ivory into the U.S. but did not result in a reversal of the elephant's decline. In 1988, Congress passed the African Elephant Conservation Act, which provided a mechanism for funding major elephant conservation projects (see related story in this edition) and authorized the President to place a ban on ivory imports. Such a ban was announced in June 1989 (see

## Ash Meadows

(continued from page 5)

to favor native species over the unwanted exotic species. We anticipate that through a combination of habitat manipulation, trapping, and (possibly) chemical treatment, exotic species can be extirpated from many, if not all, of the spring systems and that self-sustaining populations of the native

**Bulletin Vol. XIV, No. 6).** The U.S. then reinforced this action by voting with the majority of CITES Parties to transfer the African elephant to CITES Appendix I, thereby prohibiting commercial ivory trade among signatory countries. In fact, the U.S. was one of the countries that proposed the transfer of the African elephant from Appendix II, which allows for a regulated trade, to Appendix I.

The March reclassification proposal was in response to a petition from several animal protection and conservation organizations to list the African elephant rangewide as an Endangered species. After conducting a status review, the Service decided to propose reclassifying all populations as Endangered except those in Botswana, Zimbabwe, and South Africa, which would remain listed as Threatened. The Service believes that populations in these countries are being managed under effective conservation programs and that their numbers are stable or increasing.

Permits for the import of Endangered species are available only for scientific and/or conservation purposes. For Threatened species or populations, import permits also are available for zoological exhibition, other educational purposes, and — under certain circumstances — regulated sport hunting trophies. The rationale for trophy imports is that the mor-

(continued on next p.)

fishes can be successfully reest-  
lished. . . .

Copies of the Ash Meadows Spe  
Recovery Plan can be purchased  
writing the Fish and Wildlife Re  
ence Service, 5430 Grosvenor L  
Suite 110, Bethesda, Maryland 208  
or call toll-free at 1-800-582-34  
(In Maryland, call 1-301-492-640.



# United States Department of the Interior



FISH AND WILDLIFE SERVICE  
FISH AND WILDLIFE ENHANCEMENT  
RENO FIELD OFFICE

4600 Kietzke Lane, Building C-125  
Reno, Nevada 89502-5093

NT DOI 1992b

May 20, 1992 /

File No. 1-5-91-F-225

Mr. [REDACTED]  
Manager, Nevada Operations Office  
U.S. Department of Energy  
P.O. [REDACTED]  
Las Vegas, Nevada 89193-8518

ACTION \_\_\_\_\_  
INFO \_\_\_\_\_  
MGR. \_\_\_\_\_  
\_\_\_\_\_   
\_\_\_\_\_   
AMC \_\_\_\_\_

Dear Mr. Aquilina:

Subject: Biological Opinion on Nevada Test Site Activities

This Biological Opinion responds to your request dated August 1, 1991, for formal consultation with the Fish and Wildlife Service (Service) pursuant to section 7 of the Endangered Species Act of 1973, as amended (Act). At issue are impacts that specific Department of Energy, Nevada Field Office (DOE/NV) activities planned for fiscal years 1992 through 1995 at the Nevada Test Site (NTS) may have on the desert tortoise (*Gopherus agassizii*), a federally listed threatened species. Your request was received on August 2, 1991, and consultation was initiated on that date. DOE/NV granted the Service an extension to January 17, 1992, by letter dated December 13, 1991. The Service provided DOE/NV a draft Biological Opinion on February 26, 1992 and received comments back from DOE/NV on April 1, 1992.

This Biological Opinion was prepared using information contained in the Nevada Site Development Plan - Nevada Test Site executive summary (Department of Energy 1990); Biological Assessment of the Effects of Activities of the U.S. Department of Energy Field Office, Nevada on the Threatened Desert Tortoise (DOE/NV 1991); The Distribution and Abundance of Desert Tortoises on the Nevada Test Site (EG&G/Energy Measurements 1991); a letter dated December 13, 1991, from Dr. Donald Elle, DOE/NV Director of the Environmental Protection Division; obtained during our December 11, 1991 meeting; from several telephone conversations; and contained in the Service's Reno Field Office files.

## Biological Opinion

It is our Biological Opinion that specific DOE/NV activities at NTS planned for fiscal years 1992 through 1995 are not likely to jeopardize the continued existence of the threatened Mojave population of the desert tortoise.

NT DOI 1995a



# United States Department of the Interior

FISH AND WILDLIFE SERVICE  
NEVADA STATE OFFICE  
4600 KIETZKE LANE, BUILDING G-125  
RENO, NEVADA 89502-5093

June 23, 1995  
File No. 1-5-95-SP-264

Donald R. Elle, Director  
Department of Energy  
Environmental Protection  
Division  
Post Office Box 98518  
Las Vegas, Nevada 89193-8518

ACTION  
INFO  
MGR  
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APESH  
AHO  
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*Handwritten signature: E. P. D. H.*  
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Dear Dr. Elle:

Subject: Verification of Species List for the Nevada Test Site, File No. 1-5-95-SP-110

As requested by your letter dated May 25, 1995, we have searched our records for changes to the species list dated February 7, 1995, File No. 1-5-95-SP-110,<sup>1</sup>. To the best of our knowledge, there are no additions or changes to the list of threatened or endangered species. Verification of this list fulfills the requirement of the Fish and Wildlife Service (Service) to provide a species list pursuant to section 7(c) of the Endangered Species Act of 1973, as amended. Section 7 implementing regulations (50 CFR § 402.12(c)) require that after 90 days, the Federal agency must verify with the Service, the current accuracy of the species list.

For your consideration, we have provided a revised list of candidate species that may be present on the Nevada Test Site (Enclosure A). These candidate species are currently being reviewed by the Service and are under consideration for possible listing as endangered or threatened. Should surveys reveal that candidate species may be adversely affected, you may wish to contact our office for technical assistance. One of the potential benefits from such technical assistance is that, by exploring alternatives early in the planning process, it may be possible to avoid conflicts that could otherwise develop, should a candidate species become listed before the project is completed.

<sup>1</sup>Species List File No. 1-5-95-SP-110, dated February 7, 1995, replaced Species List File No. 1-5-94-SP-110, dated March 10, 1994; Species List File No. 1-5-94-SP-110 replaced Species List File No. 1-5-93-SP-270, dated June 29, 1993; Species List File No. 1-5-93-SP-270 replaced Species List File No. 1-5-92-SP-337, dated July 28, 1992; and Species List File No. 1-5-92-SP-337 replaced Species List File No. 1-5-92-SP-117 dated February 21, 1992.

Donald R. Elle, Director

File No. 1-5-95-SP-264

Please reference the species list file number shown on Enclosure A in all subsequent correspondence. Please contact Mark Maley at (702) [REDACTED] if you have any questions.

Sincerely,

*Stanley H. Weinberger*

for Carlos H. Mendoza  
State Supervisor

Enclosure

ENCLOSURE A

LISTED ENDANGERED AND THREATENED AND  
CANDIDATE SPECIES THAT MAY OCCUR ON  
THE NEVADA TEST SITE

File No. 1-5-95-SP-264

Endangered Species

Bird

American peregrine falcon

*Falco peregrinus anatum*

Threatened Species

Reptile

desert tortoise

*Gopherus agassizii*

Candidate Species

Mammals

- 2 pygmy rabbit
- 2 spotted bat
- 2\* greater western mastiff
- 2 Allen's big-eared bat
- 2\* California leaf-nosed bat
- 2 small-footed myotis
- 2 long-eared myotis
- 2 fringed myotis
- 2 long-legged myotis
- 2 Yuma myotis
- 2\* pale Townsend's big-eared bat

*Brachylagus idahoensis*  
*Euderma maculatum*  
*Eumops perotis californicus*  
*Idionycteris phyllotis*  
*Macrotus californicus*  
*Myotis ciliolabrum*  
*Myotis evotis*  
*Myotis thysanodes*  
*Myotis volans*  
*Myotis yumanensis*  
*Plecotus townsendii pallescens*

Birds

- 2 western burrowing owl
- 2 black tern
- 2 least bittern
- 2 ferruginous hawk
- 2 white-faced ibis

*Athene cunicularia hypugea*  
*Chlidonias niger*  
*Ixobrychus exilis hesperis*  
*Buteo regalis*  
*Plegadis chihi*

Reptile

- 2 chuckwalla

*Sauromalus obesus*

Plants

- 2 Eastwood's milkweed
- 2 white bear desert poppy
- 1 Beatley milk-vetch
- 2 Eastwood's milkweed
- 2 black wooly-pod
- 2 Cane Spring evening primrose
- 2 sanicle biscuitroot
- 2 Pahute green gentian
- 2 Kingston bedstraw
- 2 White-margined beardtongue
- 2 Amargosa beardtongue

*Asclepias eastwoodiana*  
*Arctomecon merriamii*  
*Astragalus beatleyae*  
*Astragalus eastwoodiana*  
*Astragalus funereus*  
*Camissonia megalantha*  
*Cymopterus ripleyi* var.  
*saniculoides*  
*Frasera pahutensis*  
*Galium hilendiae* ssp.  
*kingstonense*  
*Penstemon albomarginatus*  
*Penstemon fruticiformis* ssp.  
*amargosae*

Plants (cont.)

2 Pahute Mesa beardtongue  
2 Beatley phacelia  
2 Parish's phacelia

*Penstemon pahutensis*  
*Phacelia beatleyae*  
*Phacelia parishii*

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Category 1: Taxa for which the Fish and Wildlife Service (Service) currently has on file substantial information on biological vulnerability and threat(s) to support the appropriateness of proposing to list them as endangered or threatened species.

Category 2: Taxa for which information now in possession of the Service indicates that proposing to list them as endangered or threatened species is possibly appropriate, but for which substantial data on biological vulnerability and threat(s) are not currently known or on file to support the immediate preparation of rules.

\*\*\* Taxa known to occur in Nevada, but omitted in error from the historic range listed in the 1994 Animal Notice of Review.

**THE DISTRIBUTION AND ABUNDANCE  
OF DESERT TORTOISES  
ON THE NEVADA TEST SITE**

**JANUARY 1991**

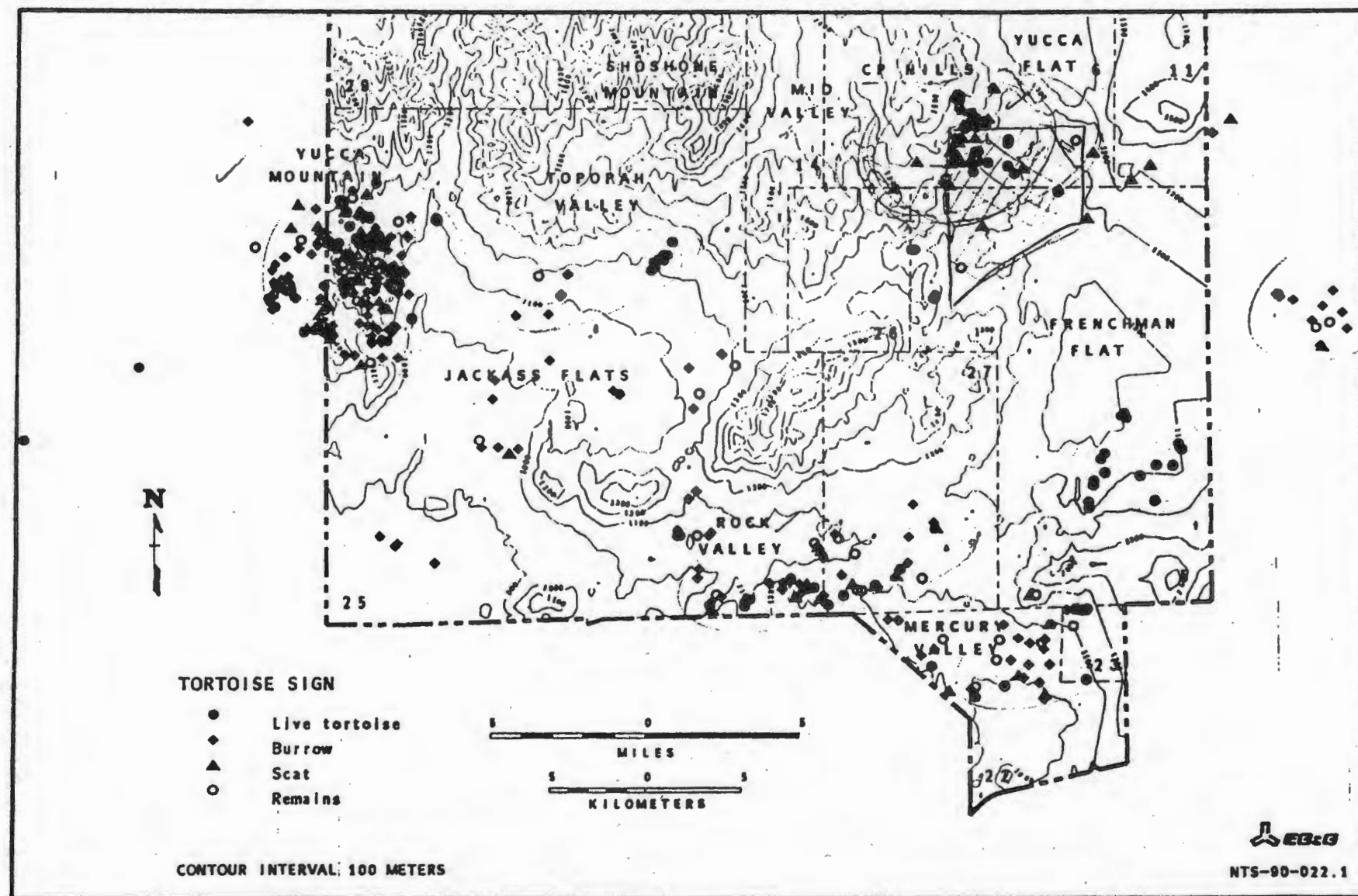


Figure 5 All sign of tortoises found on the Nevada Test Site during 1981-1986 transect studies and 1987-1990 population and impact monitoring studies.

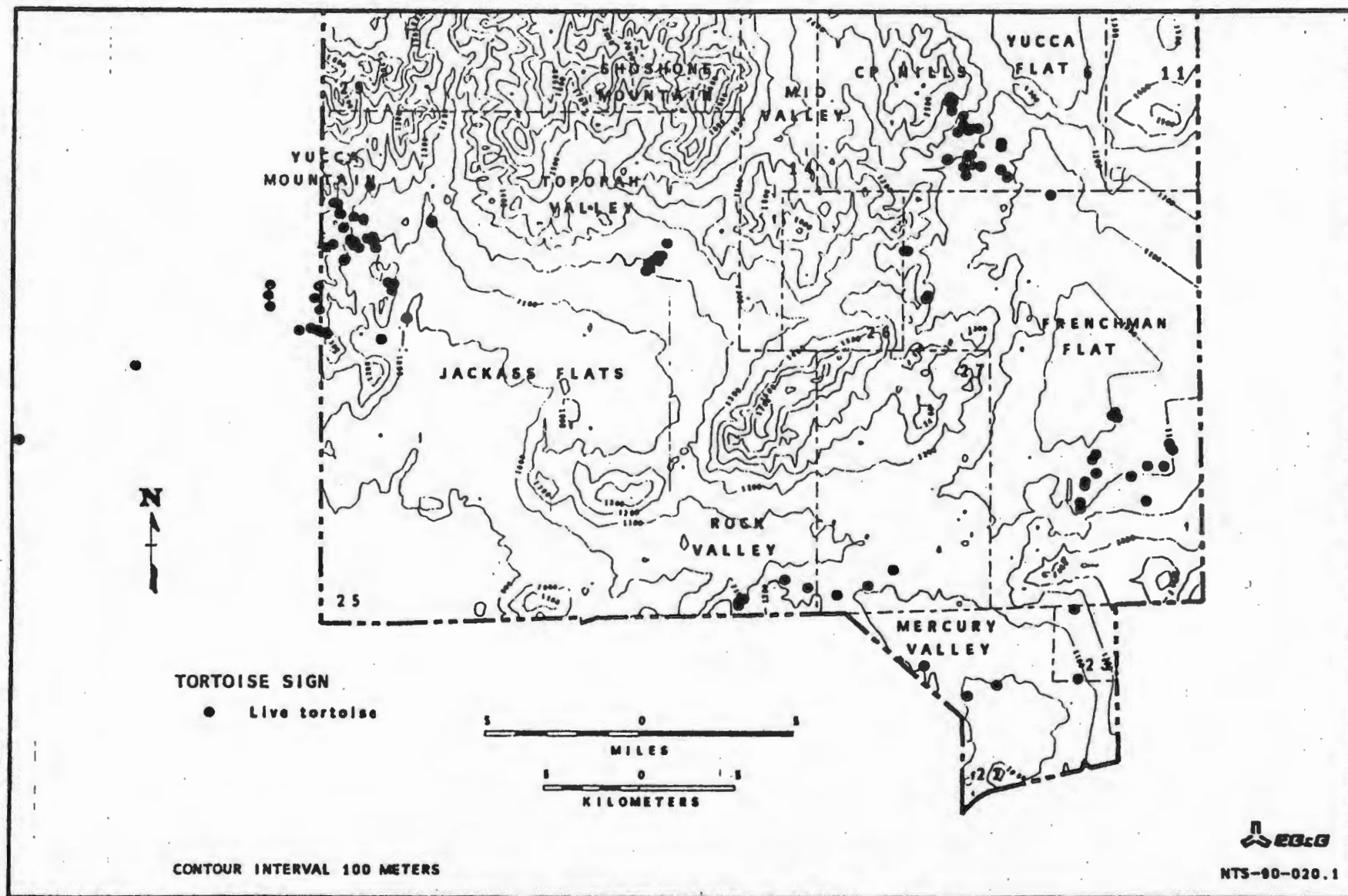
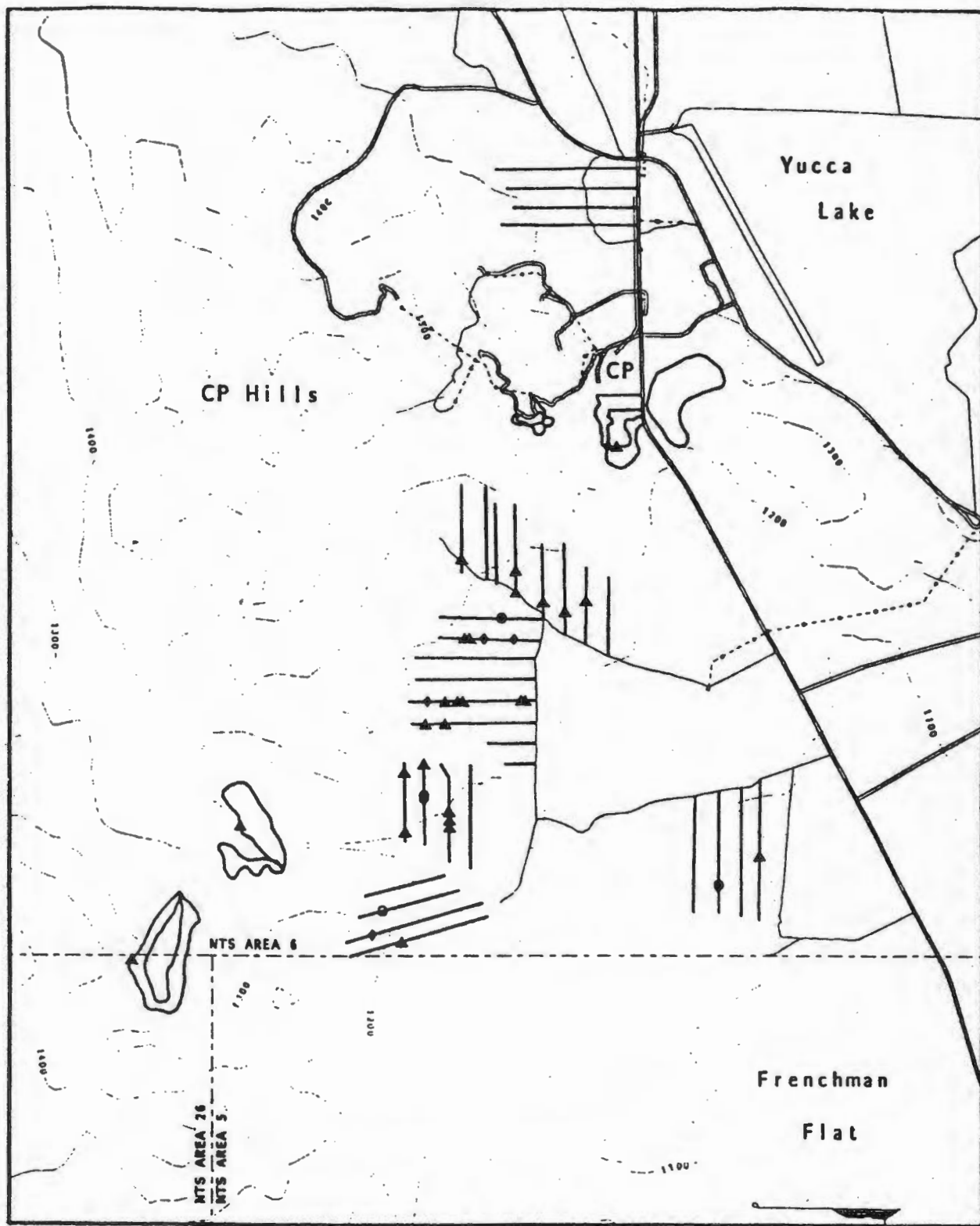


Figure 6 All tortoises found on the Nevada Test Site during 1981-1986 transect studies and 1987-1990 population and impact monitoring studies.



#### TORTOISE DATA

- Transects walked
- Live tortoise
- ◆ Burrow
- ▲ Scat
- Remains

#### BASEMAP FEATURES

- Primary road
- Secondary road
- Improved road
- Unimproved road
- - - - - Transmission line

EG&G

NTS-90-010.1



1 0 1  
MILES

1 0 1  
KILOMETERS

Contour interval 100 meters

Appendix 1b. Transects walked and tortoise sign found around CP Hills during 1985-1987.